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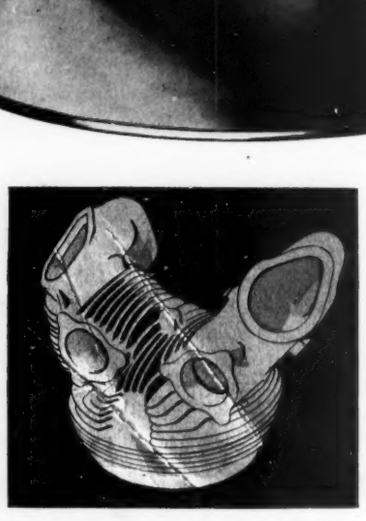

Continuous improvements in mechanical properties of Aluminum Alloys, and advances in foundry and forging practice are contributing to engine performance and life. Left: A recent cylinder head of Alcoa Aluminum.

ALCOA ALUMINUM

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AVIATION

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THE OLDEST AMERICAN AERONAUTICAL MAGAZINE

Louis F. Stoll, Vice-President

Edward P. Warner, Editor
ON LEAVE OF ABSENCE

Leslie E. Neville, *Managing Editor* · S. Paul Johnston, *Associate Editor* · Daniel Sayre, *Assistant Editor* · David J. Leisk, *Art Director* · Paul Wooton, *Washington*

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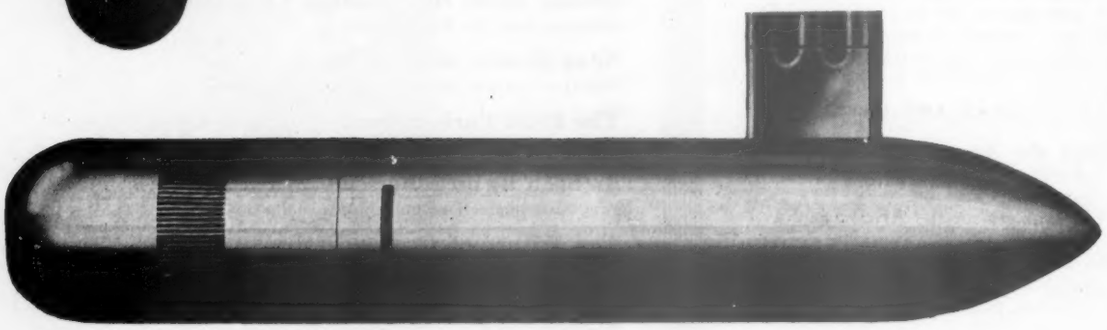

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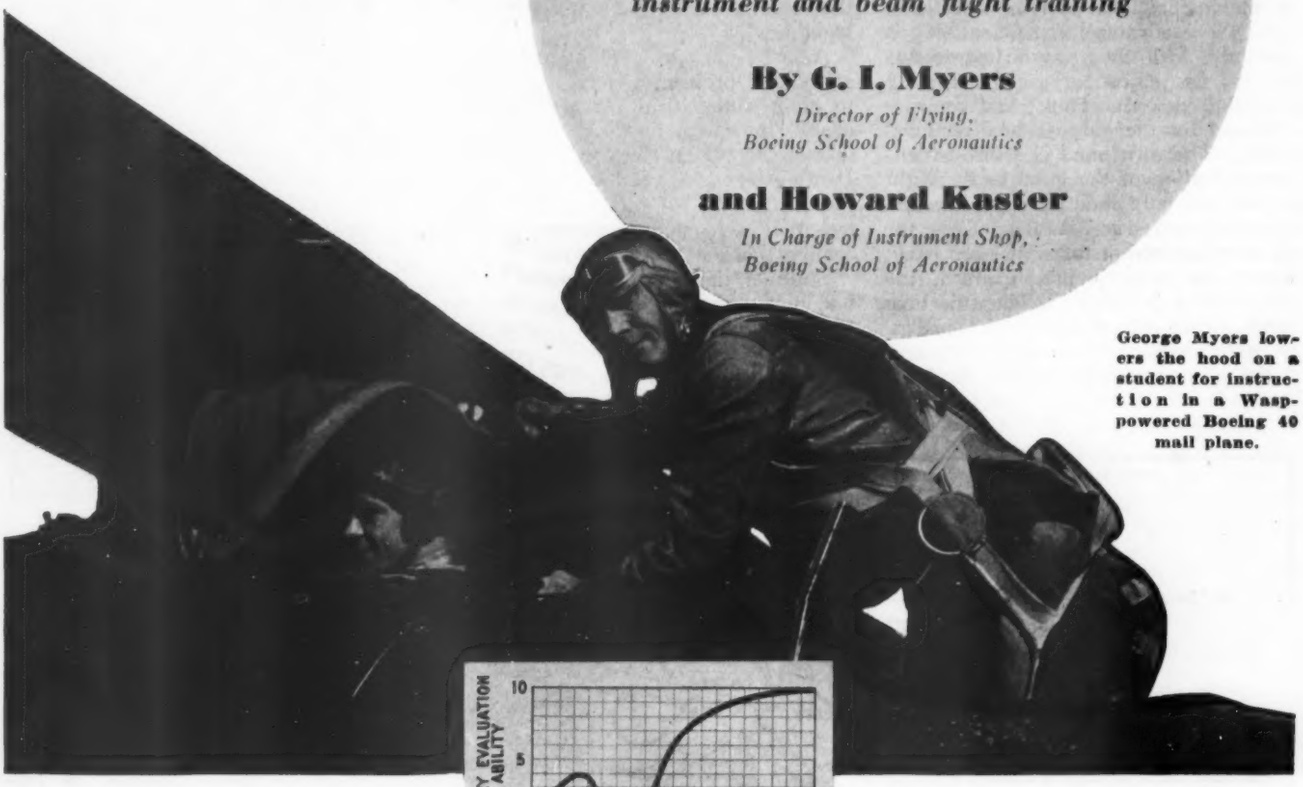
Under the Hood

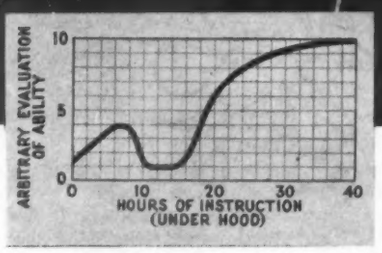
Reactions of the student to modern instrument and beam flight training

By G. I. Myers
Director of Flying, Boeing School of Aeronautics

and Howard Kaster
In Charge of Instrument Shop, Boeing School of Aeronautics



George Myers lowers the hood on a student for instruction in a Wasp-powered Boeing 40 mail plane.



Rate of progress of average instrument flying student. A long period of discouragement after early success precedes the final accomplishment of the technique. The value of ten represents the ability of the average fully competent instrument pilot.

IN THE practice of instrument flying, as in other phases of aviation, complete and thorough knowledge, properly applied, is the only possible safeguard. In addition, this knowledge must be applied with skill and precision for it to be fully effective. The modern basis of airline operation is safety,—comfort,—efficiency, in that order of importance. The study of instrument flying, meteorology, etc., is not undertaken with the purpose of attempting to fly under impossible or hazardous conditions, but to allow normal operations to be completed more efficiently and to take care of the unforeseen in a safe, positive manner.

Learning instrument flying is a long, detailed operation, involving many hours of study and practice, extending over many weeks. The pilot whose early flight training has been properly controlled and coordinated will learn to fly by instruments quicker and often more accurately than the pilot whose experience has been less closely supervised, and accordingly has not learned the proper coordination of mind and muscle, and who is less able to "think through a maneuver" than he is to fly through it.

At one time the most difficult part of the training was in developing sufficient confidence in the instruments for the student to rely upon them. This is no longer true. The students now receive sufficient technical instruction for them to fully appreciate the instrument as such. This instruction will be detailed later. There is, however, some unconscious restraint that brings about the early difficulties in the actual flight instruction. Two major difficulties invariably develop; namely, tenseness on the part of the student and inability to interpret his instrument board and react physically to what he sees. When first under the hood very few men will interpret their compass correctly and turn in the correct direction to reach a

desired compass course. It would seem that any pilot with several hundred hours to his credit would not make this mistake, but 90 per cent of them will turn the wrong way. It seems that under the hood, where the sight of outside objects is lost, the mind invariably interprets the compass incorrectly. However, this fault is easily corrected. The elimination of tenseness and the physical reaction to the visual requires considerable time. Sometimes it is necessary to fly the student under the hood for several hours continuously before tenseness is broken by fatigue.

The Bureau of Air Commerce requires the Scheduled Air Transport Rating test to be taken without the aid of the artificial horizon or directional gyro. The advanced instrument ship is equipped with these gyro instruments but for the major part of the training only the "turn and bank" and compass are used for the purpose of directional flight. The turn hand is set so a definite deflection of the hand to the right or left not only indicates the direction of turn but the *rate* of turn. Thus, for all purposes except turns of steep bank, where the controls are reversed, the rate of turn is definite. Thus the turn hand of the "turn and bank" instrument becomes the key for instrument flight. As accessories to this, the bank indicator, rate of climb, airspeed, compass, sensitive altimeter, tachometer, and other motor instruments are available.

Indications of tenseness

Tenseness is indicated on the controls in two ways: first, by the pressure of the feet on the rudder, and second, by the waving of the stick. As the turn hand is the key instrument and is controlled by the rudder, rudder tenseness is the first fault to eliminate. All students at first will brace themselves on the rudder, pushing one foot against the other and say that the rudder worked very hard as they had to push hard to effect the turn. However, when they can be persuaded to keep their heels on the floor of the cockpit, resting the balls of their feet on the rudder pedals and pull one toe back as the other went forward, they have no difficulty in moving the rudder and correcting the position of the turn hand.

Next, the student tends to guide the ship with the stick, forgetting the rudder. As the rudder controls the direction or turn indicator, it is the key control and the stick becomes only an aid to the rudder. Thus the movement of the stick should be secondary until considerable progress has been made, when the student begins to use the two together.

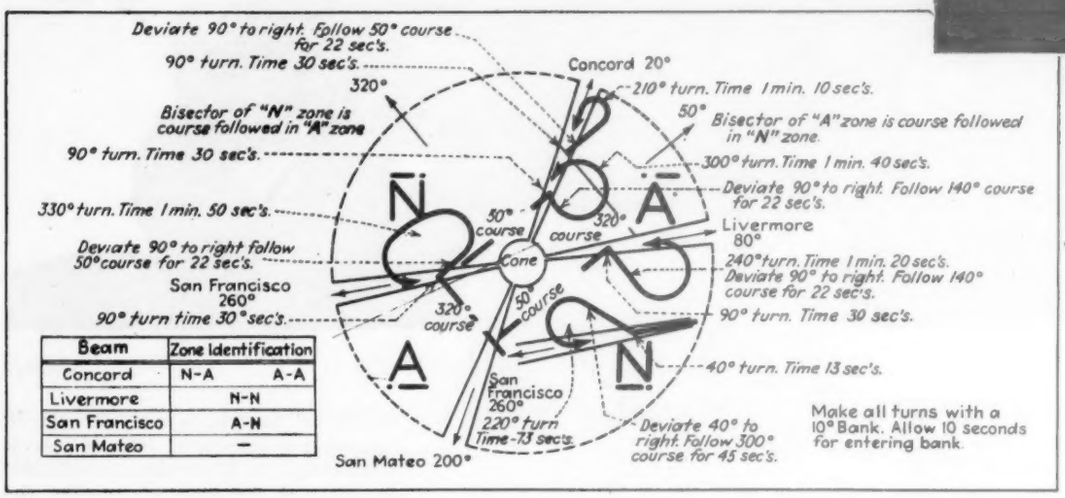
As the problem of tenseness is solved, the problem of physical reaction to sight automatically begins to solve itself. However, these twin difficulties do not solve themselves in a few hours. It often takes 15 to 20 hours of under-the-hood flying before the student really feels that he is making progress in overcoming them.

So far in the instrument flying he has had only to interpret what he sees on the instrument board. After a few hours, he is given the radio beam. He has flown the beam outside the hood with the instructor and by himself, so he knows the pattern of the beam and the method of flying it. It is not new to him except that he has not tried to fly it under the hood. He must now not only interpret and react to what he sees but also to what he hears and must coordinate the two of them. A typical beam-station pattern and the method of getting on the beam with the familiar A & N zones is shown in one of the accompanying illustrations.

A student works hard under the hood. About 50 minutes is all one can take at first, and then the time can be gradually increased. For the first 50 minutes or so he does fairly well, the next 30 to 40 minutes he is terrible, and then is so tired he unconsciously relaxes and soon begins to enjoy his flight. After one such experience he generally progresses faster.

It has been our experience that the first six or eight hours of hooded flying leave the student with a false sense of security. When one has studied the instruments, as will be detailed later, and thoroughly appreciates them, he goes under the hood definitely confident as to their uses, purposes, and

Above: Instrument flight training over Oakland airport.


Deviate 90° to right. Follow 50° course for 22 sec's.
90° turn. Time 30 sec's.
320°
Bisector of "N" zone is course followed in "A" zone
90° turn. Time 30 sec's.
330° turn. Time 1 min. 50 sec's.
Deviate 90° to right follow 50° course for 22 sec's.
San Francisco 260°
90° turn time 30° sec's.
Concord 20°
210° turn. Time 1 min. 10 sec's.
50°
Bisector of "A" zone is course followed in "N" zone.
300° turn. Time 1 min. 40 sec's.
Deviate 90° to right. Follow 140° course for 22 sec's.
Livermore 80°
240° turn. Time 1 min. 20 sec's.
Deviate 90° to right. Follow 140° course for 22 sec's.
90° turn. Time 30 sec's.
40° turn. Time 13 sec's.
Deviate 40° to right. Follow 300° course for 45 sec's.
Make all turns with a 10° Bank. Allow 10 seconds for entering bank.
San Francisco 260°
220° turn Time-73 sec's.
San Mateo 200°
50° course
320° course
Cone
Beam | Zone Identification
Concord | N-A A-A
Livermore | N-N
San Francisco | A-N
San Mateo | —

Left: Pattern of the D. of C. radio beam station at Oakland Airport showing an improved method of locating the beam and the cone of silence.

value. He accordingly does fairly well in his early practices. For the first seven to ten hours of under-the-hood flying he progresses slowly but steadily and acquires a certain standard of skill that will apparently develop steadily to a point that can be considered full competency. He then invariably gets worse and worse until it is even apparent to the student that he is unable to get any results. Frequently he despairs of ever learning at all. It will then take him from five to eight hours to even begin to regain his former ability. His progress will then usually be very rapid and he will soon be able to fly smoother and more positively under the hood than he was previously able to do outside of it. It would seem that a minimum of 25 hours of hooded instrument flying is necessary before a pilot can be considered fully competent when visibility is non-existent.

Rate of progress

The above is not the experience with a few isolated cases but has been apparent with every pilot given instrument flying by the school since January, 1930, when this system of instruction was first put into operation. Fig. 1 shows the rate of improvement of the average student in instrument flying.

The instruments instruction, with which is included radio communication, is designed to satisfy one of two purposes, according to the choice of the student:

1. Develop men capable of taking positions on the airlines either as instruments or radio maintenance men or as dispatchers, in accordance with the ability, aptitude, and choice of the man.

2. Train pilots to meet the exacting requirements laid down by the Bureau of Air Commerce, Department of Commerce, and by the management of United Air Lines.

The training for both purposes goes through exactly the same procedure, the practical application alone being different.

All students spend two hours a week in lecture and discussion of the theory of aircraft instruments. This covers such matters as the principles of operation, relative advantages and disadvantages of various types, and the methods of testing, calibrating and repairing instruments. This is all fairly easy for students who have had a course in high school physics or the equivalent. Other students must acquire such information in another course given at the school.

A thorough knowledge of elementary scientific principles will enable anyone to understand the operation of any aircraft instrument of the past, present, or future, and will enable him to explain the advantages or defects of any of the new "inventions" which continually appear in this field. For this and other reasons the lecture work is planned to stress scientific principles rather than mechanical details. That this procedure does not satisfy everybody is shown by the statement of a freshman who became lost in a discussion of quadrantal and semicircular deviations and then announced in front of the class that he had been personally acquainted with several aviators back home in C——— and that he was certain that "they didn't know anything at all about all this stuff."

However, by the end of his first quarter this student will probably be able to explain better than his experienced aviator friends such interesting things as why a magnetic compass shows a left turn when the plane is turning right under some conditions; why it is subject to acceleration errors on easterly and westerly courses; why it is in general impossible to fly "blind" without some other directional instrument. He will also know why the pointer of a gyro "turn indicator" is on zero when a plane makes the sharpest turn possible and why it is a yawing indicator and not a turn indicator at all; why a "ball bank indicator" is not a bank indicator but is a skid and side-slip indicator. If an air speed indicator reads 150 m.p.h. when the altimeter reads 8,000 feet he will know that the true air speed is about 175 m.p.h. and will know how to apply further corrections for temperature if greater accuracy is desired.

These and many other things unknown to many pilots of barnstorming days must be as familiar as the alphabet to the modern scheduled air transport pilot.

Limitations in instruments

Another important part of the lecture course produces a curious reaction on the part of some students. All instruments have certain disadvantages or limitations and a thorough knowledge of these is of the greatest importance to the pilot. In fact, it would be very dangerous for a pilot to fly by instruments without knowing these limitations. There are plenty of well known stories of pilots who have gotten into a spin while watching a compass, or who have come down through a thick cloud layer by keeping a turn indicator hand approximately on zero, only to find that they have turned 180 deg. in the process. Such things can be placed beyond possibility of happening only by emphasizing the limitations of each instrument and in some cases the dependence of

one instrument upon the reading of another. If this is done it is difficult to see how one can have much criticism to make of modern instruments from the safety viewpoint. Everyone will admit that even such a highly developed mechanism as the modern automobile has limitations, such as requiring low speeds on sharp turns or on a very bumpy road, or a clear head at the wheel. Yet there is something in the nature of many human beings which causes them to expect that any mechanical device called an instrument must function perfectly under all conditions. After discussing such things as northerly turning errors and acceleration errors of compasses, barometric corrections for sensitive altimeters, the fact that one air speed installation is subject to alignment and clogging errors while an alternate type is not as sensitive at low speeds, the necessity for frequent resetting of directional gyros, etc., it is about time to expect some student to say: "Well, if none of these instruments are any good when do we study some good ones?"

Electrical misconceptions

Radio theory and the study of electricity are handled in a similar manner. Many of the students have a smattering of radio theory and some have rather weird ideas that must be disproved.

All students taking the lecture course spend three hours in the instrument laboratory each week. In this work the class is divided into six small groups and each group given a different problem. One group will be compensating compasses with different types of compensators, another calibrates altimeters or air speed indicators. A party may be performing certain experiments with demonstration gyroscopes in order to become familiar with the fundamental gyroscopic principles, and then open an actual artificial horizon, a directional gyro, and a gyro turn indicator, in order to study the mechanical details of an actual instrument. Thereafter no member of this party is expected to make an error so common among pilots of calling a "directional gyro" a "gyro compass." In fact, each student is expected to be able to explain why a gyro compass and a directional gyro operate on entirely different physical principles.

After completing the laboratory course the student should be able to diagnose and correct most of the more common instrumental difficulties. His laboratory work has taught him how to handle a sensitive hair spring, how to make almost microscopic adjustments in some cases, and of course has developed the habit of handling small ball bearings without spilling them on the floor and the habit of making a reassembled instrument contain the same number of parts as came out of it.

Radio practice is studied in the laboratory by the application of the principles developed in the lecture courses to actual sending and receiving sets. An experimental ultra short wave transmitter, W10XAZ, is part of the equipment as well as several orthodox receivers. Students studying to become dispatchers work toward a second class radio telephone operator's license while the pilots require a third class radio telephone license. All students learn code for signalling and recognition of beacon lights and radio identification.

By the time flying students are ready for practice in a hooded cockpit they are familiar with the principles of operation of the various instruments and understand the theory of using them in such combinations as the X-Y-Z and the 1-2-3 systems of instrument flying. This knowledge would be of little value without the many hours of flight practice which makes reactions instinctive, yet without a thorough knowledge of instrument theory the student could not recognize the danger of wrong methods which might work in smooth air but fail under bad storm conditions.

Another application is found in the aerial surveying course. As a part of the work in this course six photography students and an advanced student pilot (accompanied by a flight instructor) go out in a cabin plane to make vertical photographs of a certain strip of territory. To do this requires flying at a very constant altitude, starting over a certain mark and continuing on a very steady course. The student pilot knows from his ground work that to do this he must not use his compass for steadying the direction and that he must not look down at the point he intends to fly over. In other words, he is aware of the physical limitations of instruments and the effect of accelerations which made bombing so inaccurate before the theory of approach curves had been developed, and he knows the common sense solutions. His first flight is considerably more accurate than anything he could do after long practice if such practice were undertaken without a knowledge of the proper procedure.

Making instrument repair men

Students studying to become radio or instrument repair men must spend a great deal of time in special preparation. A minimum of twenty-one hours a week is devoted to this work. As far as possible all the students' effort is made along practical lines on radio and instrument equipment from the school airplanes.

In all instruments the moving parts wear at points of contact, diaphragms, springs and magnets change their shapes, elasticity and other characteristics so that periodical tests must be made and any errors corrected. In time parts must be replaced. The accuracy of instruments is of special importance in the hooded cockpit planes used for instrument flying practice. The necessary testing, adjusting, and repairing provides an opportunity for a few advanced students to become familiar with work of this sort. Students who wish to do so and whose records in the elementary courses show that they have the necessary ability and temperament are allowed to specialize in this work. Between two and five students do this each quarter. To be successful such students must have more than the normal amount of patience. They must have the sort of ingenuity that can build almost anything from bits of metal and they must reason analytically and in terms of scientific principles. When an instrument fails to perform properly this fact must start a train of thought which considers in turn each spring, lever, pivot, etc., from one end of the instrument to the other. The source of trouble must be accurately judged, verified by special tests, and the mechanical details of correction applied with skill.

In addition to acquiring mechanical training the students who specialize in instruments often have interesting contacts with pilots. Sometimes this results in an airplane ride when it can be made to seem reasonable that the functioning of a certain instrument should be observed in the air. Sometimes they are reminded that guess work preceded precision in piloting. This was the case a year or two ago when a pilot with several thousand hours reported that the new artificial horizons were indicating twice the true angle of bank—a mechanical impossibility, but at least good for some discussion and a ride.

Flight technique changing

Flying has recently changed from a good weather activity full of guesswork to what is practically an all weather affair of precision. This change would not have been possible without the development of modern radio and instruments. Years of practice will not enable a pilot to fly "blind" (without instruments) in bad weather any more than years of practice will enable him to jump over a house. The physical impossibilities are equal in magnitude. The development of instruments has made it possible for a pilot to do what was formerly impossible, but this has added greatly to the technical knowledge required of pilots. A thorough knowledge of all phases of instrument theory and practice is now necessary but in addition to this there are a number of indirect results. Much more knowledge of meteorology is required of pilots who fly through conditions which are ordinarily avoided—conditions involving such things as ice formation, etc. Radio has become a major factor in air transport and the end has not yet been reached, for radio landing beams are now being installed and will soon provide an entirely new set of problems for the pilot, radio, and instrument men.

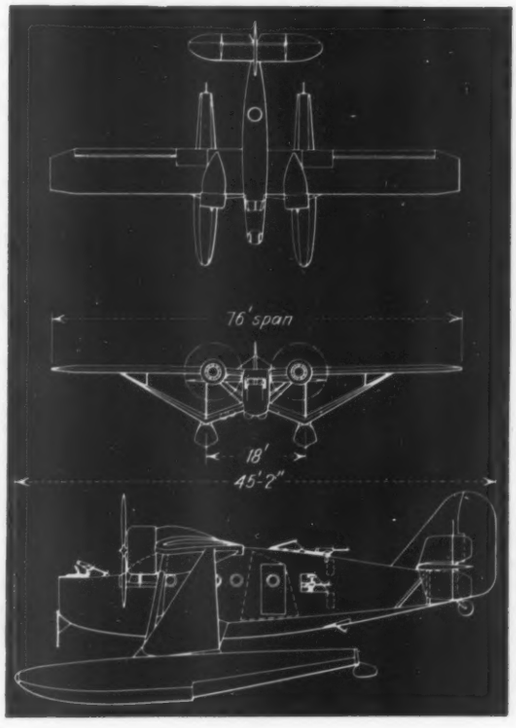
Bellanca Bomber

Empty weight, 9,362 lb.; gross, 17,749 lb.; top speed, 175 m.p.h.; range, 1,500 miles.

Empty weight, 8,216 lb.; gross, 16,333 lb.; top speed 190 m.p.h.; range 1,500 miles.

METAL monocoque design has made such spectacular advances in this country during the past few years, that the steady progress achieved in welded tube structural technique during the same period has received less than its fair share of approbation. Certainly the simplicity and efficiency of the new Bellanca Bombers is ample indication that the steel tube type of construction continues to match any other in over-all effectiveness. The useful load-gross weight ratio of .497 which this bomber has as a land plane, or of .473 which it achieves when equipped with seaplane floats insures it a tribute in any design discussion. Its top speed of 190 m.p.h. (175 m.p.h. as a seaplane) and its 1,500-mile cruising range with over a ton of military load make it one of the most formidable of modern air weapons.

The power for the Bellanca Bimotored Bomber is furnished



by two Wright "Cyclone" Engines of 715 hp. each, fitted with controllable pitch propellers. These engines are mounted in steel tube mounts, located at the junction of the main upper wing panels and the upper stub wing. The engine nacelle structures are really a part of the upper stub wing welded tubular unit, the nacelle and wing stub being covered with aluminum alloy covering, attached by means of drive screws. The engine nacelle installation consists of the engine itself, supported on rubber-bushed engine bearers; an oil tank of welded aluminum construction of 20-gal. capacity mounted immediately behind the engine; and a compartment to the rear of the nacelle housing a cylindrical 60-gal. welded aluminum gasoline tank. A 90-gal. rectangular gasoline tank, also of welded aluminum construction, is provided in the upper stub wing unit proper, making a total of 300 gal. carried

The chrome molybdenum steel tube fuselage gives an overall impression of simplicity, yet reveals a wealth of refinement upon detailed study. Typical Bellancaisms are the use of a wide range of tubing sizes, and the occasional selection of tie rod diagonals in a constant search for the lowest possible structural weight compatible with full strength factors. Of interest is the truss braced flooring supports permitting the carrying of large concentrated loads.

The external bracing system, similar to that of the Aircruisers combines aerodynamic effectiveness with extreme adaptability of function. Not only is the conversion from seaplane to landplane very simply carried out, but skis could be easily mounted if desired. Note the large trapezoidal door facilitating the use of the ship as a cargo carrier, the ingenious steps and hand rail, the retractable water rudders. Floats are by Edo.

in the upper stub wing sections of the plane.

The fuselage is of welded chrome molybdenum steel tubing, fabric covered. Provisions are made for the use of the plane as a twelve-place transport, an ambulance, or a troop carrier. In addition, by the use of the special double-hinged cargo door located at the right rear portion of the cabin, two large-sized aircraft engines are easily accommodated in the fuselage, the floor being specially reinforced underneath by a welded, bridge-type structure.

The lower stub wings and auxiliary wings are of chrome molybdenum steel tubing, fabric covered; the upper stub wing has a chrome molybdenum welded steel tube structure also, but is covered with aluminum alloy sheet. The main upper wing panels consist of spruce spars, built-up plywood ribs, and fabric covering. The main wing panels are hinged at the point of junction of the main wing rear spar to the upper stub wing rear spar, folding back to enable storage of the plane in a comparatively small space.

All vertical tail surfaces and the elevators are of welded chrome molybdenum steel tube structure; the stabilizer has solid spruce spars and built-up plywood ribs. The entire empenage is fabric covered.

The arrangement of the vertical tail surfaces, consisting of one main rudder and fin and two auxiliary rudders and fins (all of the rudders being completely controllable from the cockpit) enables the plane to be flown in normal attitude without difficulty on either one of the two engines, actual tests having demonstrated that the ship even when mounted on floats flies easily on a single engine at 8,000 ft. altitude with full normal load.

As a seaplane, the Bellanca Bimotored Bomber is equipped with twin Edo floats, complete with retractable water rudders.

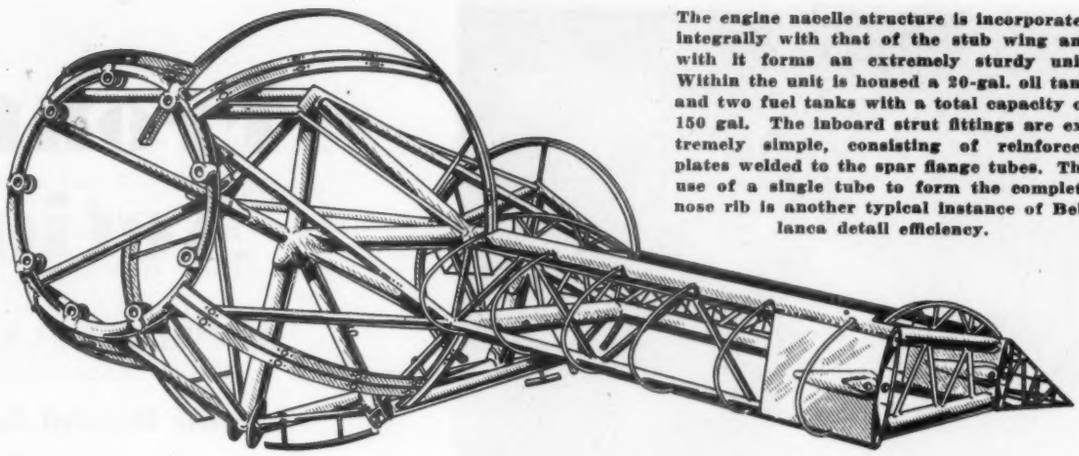
As a landplane, full Goodyear Airwheels are employed, and the tail post is provided with an Airwheel tail-wheel and shock-absorber. This combination was selected after several years of actual service experience on commercial and military cargo planes of the same general type as the Bimotored Bomber.

Provisions for armament include racks for carrying in excess of one ton of bombs, plus ammunition and fittings for the five machine gun positions. The main bomb racks are located directly beneath the forward part of the cabin, and auxiliary racks for carrying additional 30-lb. or 100-lb. bombs are provided in specially built bays in the underside of the lower stub wings.

The machine gun positions are as follows: one scarf ring mount in the nose of the fuselage; one scarf ring mount at the rear upper portion of the cabin, complete with aluminum alloy shield to protect gunner from the slipstream; two window-sill positions in rear-most windows, and one tunnel gun, operating through the bottom of the fuselage at the rear. This machine gun arrangement provides maximum protection of the plane from all angles of attack, and at the same time permits extreme effectiveness of fire for the gunners.

The Bellanca Bimotored Seaplane Bomber is capable of a range of 1,500

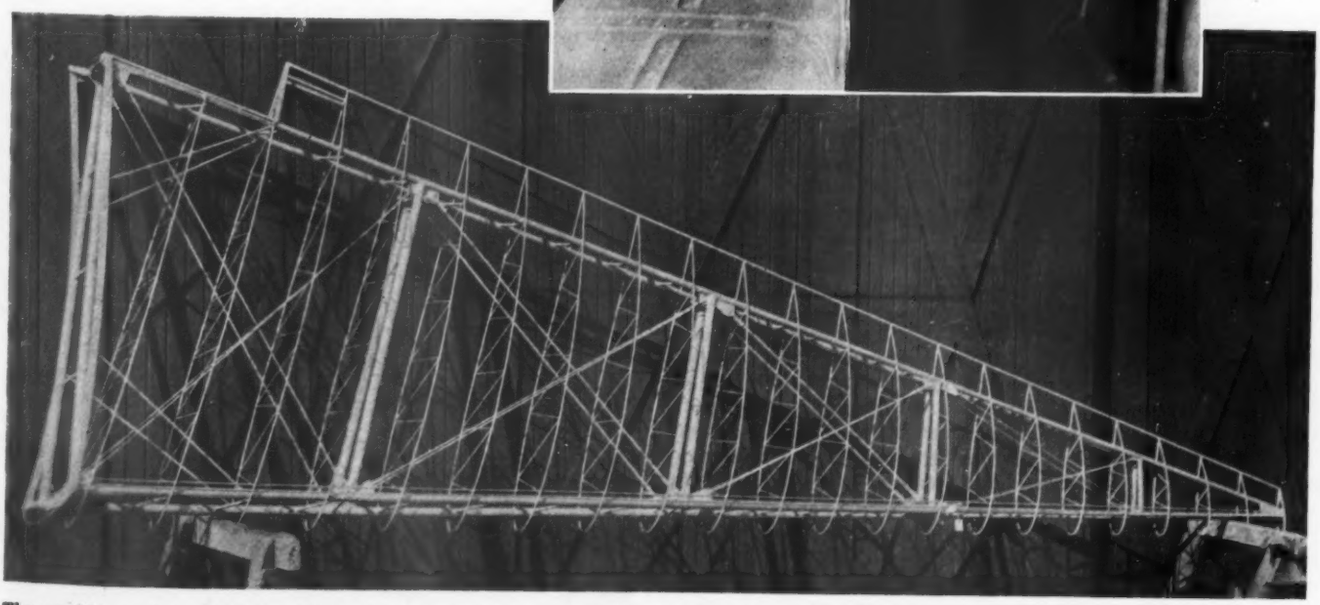
miles while carrying full bomb and ammunition load. This range is provided through the use of a removable 200-gal. rectangular shaped gasoline tank strapped to the cabin floor, as well as a 180-gal. "belly" tank beneath the fuselage, the latter being a permanent fixture. This gives a total gasoline supply of 680 gal., including the 300 gal. carried in the wings.



The engine nacelle structure is incorporated integrally with that of the stub wing and with it forms an extremely sturdy unit. Within the unit is housed a 20-gal. oil tank and two fuel tanks with a total capacity of 150 gal. The inboard strut fittings are extremely simple, consisting of reinforced plates welded to the spar flange tubes. The use of a single tube to form the complete nose rib is another typical instance of Bellanca detail efficiency.

The pilot's cockpit has a full complement of engine and navigating instruments; is equipped with wheel control, and items such as stabilizer adjustment, auxiliary rudder control, water-rudder control and retraction gear are within easy reach. The bombardier's cockpit is located to the side of and just below the pilot's cockpit; and is equipped with the proper instruments to give the altitude and speed of the plane, together with bomb-sight and bomb release handles.

The interior of the cabin with the extra 200 gal. tank in place which gives the Seaplane Bomber a range of 1,500 miles with full military load. The cabin is over 13 ft. long and 6 ft. high. Other interior arrangements provide for the use of the plane as a six-litter ambulance, as a twelve-place transport, as an eighteen-place troop carrier. Of structural interest are the tie-rod diagonals in the roof bays and the sturdy cross frame braces just aft of the pilot's seat.



The auxiliary wing structure which also serves as an external bracing for the main wing. Both spars and ribs are of tubular steel members. The ribs of the main wing are of plywood. The cut out at the inboard end of the trailing edge permits the whole outer wing structure to be folded back allowing the ship to be stored or handled within a much smaller space than would be otherwise needed.

Cirrus.

Frontal Action

By Philip Del Vecchio
American Meteorological Society
and Daniel Sayre
Assistant Editor of AVIATION

IN THE preceding article of this series we developed the basic concept of four types of air masses which intermingle to make up the atmosphere of the temperate latitudes. We also explained that these masses could be recognized through the study of certain of their temperature and humidity characteristics long after they had left their original conditioning sources—provided, of course, that the studies be carried out sufficiently high above the earth's surface to eliminate the most variable of the surface modifications.

Now, obviously, as air masses move into the temperate latitudes from their polar and tropical source regions they must come in contact with other air masses of dissimilar characteristics. The resulting impacts—or battles, as Sir Napier Shaw dramatizes them—between cold and warm, between moist and dry, will vary widely in the intensity of their local actions—depending on the particular combination of types involved and the local terrain. But the most important mechanical principle is no more complex than that warm air in motion encountering a polar air mass will be forced to run up over the colder, denser air. Conversely, a cold mass meeting or overtaking a warmer one will run under it. In either case the warm air undergoes a lifting process and as a result is cooled as it expands (adiabatically) against the reduced pressure at the higher elevations.

Warm air of comparatively high relative humidity is soon apt to reach a temperature at which its water vapor condenses if it is cooled—no matter what the process. A little later it may reach a point at which the condensation droplets are large enough to fall as rain or snow. We can expect our discontinuities between air masses, then, to be marked by cloud formations, changes in temperature and usually by regions of precipitation; and such is indeed the case.

However, there are other effects to be considered. The "fronts," as the surfaces of discontinuity between air masses are called, are never the sharp geometrical planes that one would like to think them. There is moderating of temperature differences between contact layers by turbulent mixing. There are differences of direction between isolated portions of the air masses. There are many features of surface interference which we have mentioned previously plus an added reaction between air masses encountering surfaces but recently conditioned by a preceding mass of different temperature. And so on. But the principles hold, and especially during the winter months the bulk of our weather phenomena can be visualized as the lifting of warm, moist air along the fronts between polar and tropical air masses. Which brings us to an excellent place to attempt a corelation between the air mass approach to weather phenomena and the study of low and high barometric pressure areas on the familiar weather map.

The front and the low

We might reason thus: An area of low barometric pressure is one marked by cloudiness, horizontal variations of temperature, precipitation and, by changes in wind direction. Other regions, during winter at least, are generally free from most of these phenomena. Now, if the frontal regions between dissimilar air masses are marked by the same meteorological phenomena as are observed in a low pressure area, this area, then, must be the contact center for dissimilar air masses.

Bjerknes, the Norwegian meteorologist who first set forth the air mass concept, linked it to world circulation. His postulate was that over the polar regions an area of high pressure obtained, from which cold, dry air masses were expelled in a southerly and somewhat westerly direction. From the high pressure belt of the Trades latitudes, warm, moist air masses traveled northward and eastward. The

Cirro-Cumulus.

The second of a series of articles on the fundamentals of air mass meteorology written for the non-specialist. In this installment the interaction between dissimilar masses and the resulting frontal phenomena are discussed and related to the "low."

CLOUD PHOTOGRAPHS FROM HUMPHREYS' "PHYSICS OF THE AIR"

Alto-Cumulus.

line at which these two dissimilar air masses met he called the "Polar Front." And our familiar migratory low pressure area he conceived as a tongue-like intrusion of tropical air into this polar front; which in itself, of course, is constantly shifting its position.

The central figure on page 48 clearly shows a tongue of warm tropical air pushing up into the cold air mass to the north. The advancing warm, moist mass is observed, at the surface, as a region of relatively high temperatures and occasional thundershowers until it reaches the position marked as a "Warm Front" on the diagram. At this point it is obstructed by the colder mass in its path and forced to ascend over it. As the warm air ascends it expands against the decreased pressure, as we have said before, and soon condensation is reached and the consequent rain or snow falls through the colder mass underneath. It must be understood, however, that the warm front is not often the well-defined line such as appears on the drawing. The ascension of the warm air is gradual and the "front" may be a region a hundred miles wide marked by fogs, clouds and other phenomena which we shall consider later in detail.

To the left of the advancing warm mass, the cold front makes its appearance as the northwesterly winds sweep in under the receding tropical air and again force its ascent with the usual cloudiness, turbulence and precipitation. The Polar Front, as this cold front is called, is much more definite and the changes in temperature, wind and weather are much sharper and more severe. It is interesting to note that the rain area (shaded in the diagram) is much more extensive to the east where the warm front ascension is gradual than in the west where the Polar Front (our familiar squall line or wind-shift line) rushes into the equatorial air.

In order that the drawing would not appear too complicated, the isobars, defining the low pressure area as we usually see it on the weather maps, have been omitted; but the center of the low would be near the point where the warm front joins the cold front.

Alto-Stratus and advection fog.

Flying through it

The figure at the top of the drawing is a cross-section of the phenomena as observed in the northern portion of the storm, out of the warm sector. The sequence of weather changes to a pilot flying westward along this line at an altitude of about 6,000 ft. would be about the following: At the beginning of the flight he would observe the high cirrus clouds approximately 30,000 ft. above him and as he continued his flight westward the cirrus would gradually thicken to cirro-stratus and then to alto-stratus—the ceiling constantly lowering—where he would soon enter the warm mass which was ascending over the colder mass beneath. Soon the alto-stratus would become stratus and then nimbus accompanied by rain or snow. As he pushed ahead the precipitation would stop and the nimbus become ragged stratus or alto-stratus and soon the sky would clear entirely. He would experience no severe polar front because he would not be crossing the warm sector at the ground.

On the other hand, a flight through the section shown at the bottom of the figure and which would take him through the warm sector, would go something like this: The take-off would be in cold air and the familiar cirrus clouds would be present at that time, but the clouds would thicken and lower much more rapidly than in the former case. There would soon be a rather abrupt transition from the clear cold to a foggy nimbus region with copious precipitation. After a time he would fiy out of this nimbus into the clear sector of the warm air mass. There might be a few thunderheads, products of the heat and moisture of the mass and some haze, but on the whole, fairly good flying. Then suddenly the tops of thunderheads or the squall cloud itself would become visible and the pilot would plunge in the actual cold front, marked

by excessive turbulence, rapid fall in temperature and quick clearing after squally weather.

In many storms which enter the United States, the polar mass forces itself under the entire warm sector and raises it bodily from the ground. In this case the storm has become what is called "occluded" and the polar front becomes an occluded front. As soon as this happens the low pressure area dissipates, since the warm air which is the existence of the storm has been cut off.

Why the tongue of warm air should protrude outward from the main mass and intrude on the polar mass is still controversial. In fact, it has not yet been settled as to whether it is the warm mass that begins the fracas or the cold polar air which pushes down and originates the cold front.

We can now visualize numbers of these "disturbances" strung out along the polar front which encircles the entire earth. Each has its own warm sector and polar front and in each the warm air is lifted and weather changes take place in varying degrees of intensity.

In many ways this conception, this picture, of weather as a mechanical process is one of the greatest general advantages possessed by the air mass over the pressure area system of meteorology.

American air masses

So far we have only generally outlined the broadest aspects of air masses and have separated them into Polar and Tropical, and Continental and Maritime. We have seen that the interaction between a polar and tropical mass results in storm conditions with definite fronts which are generally possible to recognize. It is now necessary to know something of the names, origins and characteristics of the particular masses which affect the United States.

The great land areas north of the United States—more specifically Canada and Alaska—supply the means for the development of the most dominating air masses which invade the country—the *Polar Continental.* In winter these land areas acquire an exceedingly low temperature and an extreme dryness which are transmitted to the air above it in no uncertain degree.

The region over which these masses form, or are conditioned, is well protected from influences which might modify the cold and dryness. In the first place the entire area is almost uniformly covered with ice and snow; and in the second place no warm Pacific air can get in over the mountains to the west in sufficient quantities to make any marked disturbance. The combination of snow covering, stagnation and active radiation of heat from the ground produces the most active source of weather breeder in the United States. As mentioned before, the general characteristics are extreme cold and dryness. When a mass of this sort moves southward and eastward into our country they do so, so steadily that forecasting becomes comparatively easy, until the polar air moves off the eastern coast.

Opposed to these characteristics are those of the tropical mass which originates in the waters of the Gulf of Mexico. Over this area, regardless of whether the air stagnates or keeps moving, the mass acquires a high relative and specific humidity at the surface and, a sub-tropical temperature. Since these masses will not be studied in detail in this article, it will be necessary to state that due to certain actions, such as settling, the *Tropical Gulf* mass, as it is called, becomes quite dry as the altitude increases: and this combination of high humidity at the surface and low humidity aloft give the mass an "unstable" quality which becomes a factor at the polar front and which will be discussed in our next installment.

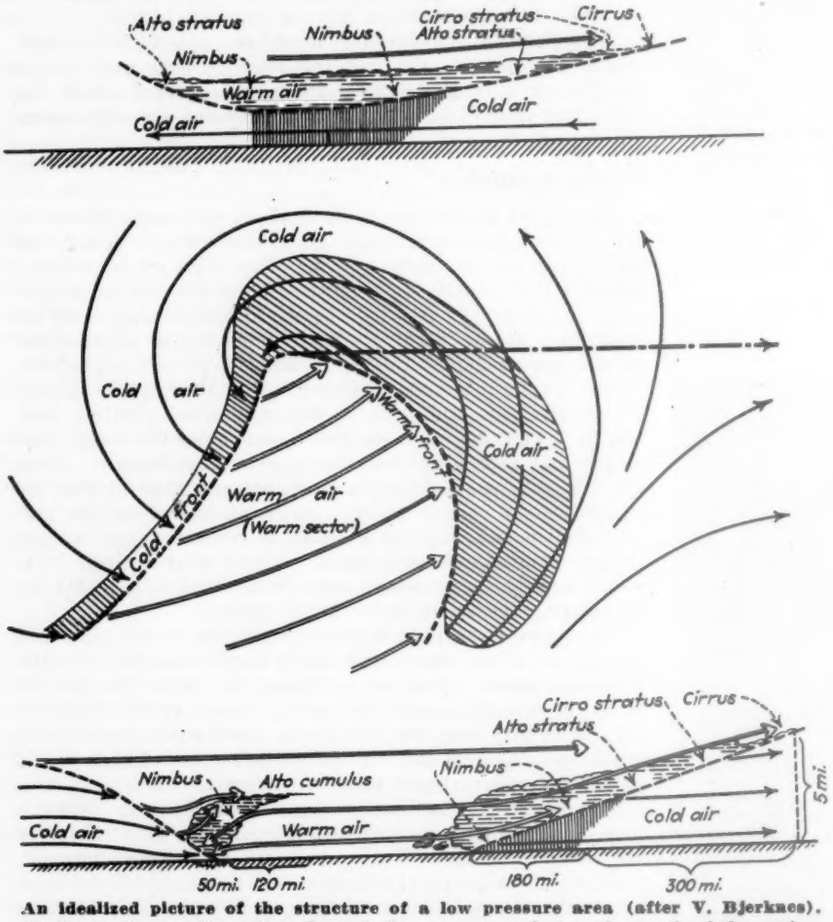
Similarly, *Polar Pacific* air masses which become conditioned over the North Pacific, while being relatively cold compared to tropical masses, have the high humidity characteristic of maritime air masses. Polar Pacific plays a great part in the weather of the entire West Coast and even invades the United States as far eastward as the Atlantic Coast—in modified form of course.

Its eastern counterpart, *Polar Atlantic,* is originated in the area north of the ship lanes and is for all practical purposes a return current of *Polar Continental* which has gone to sea for a voyage and returned with increased humidity. It comes back slightly modified as to temperature, but much more moist and is a factor in the weather of the Atlantic seaboard.

Two more masses remain to be described, but neither of these are so well recognized, nor do they exert the influence that the others do over American weather.

The region of our Southwest, over the great arid deserts and the land to the south, Mexico, forms a definite originating area for *Tropical Continental,* a hot, extremely dry and cloudless air mass which is a factor in the Southwest and as far east, perhaps, as the Mississippi valley.

Tropical Pacific, conditioned in the southern ocean of that name, is a typical maritime current, warm and moist, but not nearly so effective in the generating of disturbances as Tropical Gulf.



An idealized picture of the structure of a low pressure area (after V. Bjerknes). At the top is a section taken through the area somewhat to the north of the center. Below the plan is a section taken through the southern portion or warm sector.

Quotes from the Aviation Commission

UNDERWOOD AND UNDERWOOD

THE report of the Federal Aviation Commission, transmitted with a message to Congress by the President on Jan. 31, is a bulky document some 250 pages in length. Its contents, divided into several major sections and conveniently summarized, embraces recommendations for a broad federal aviation policy based on the findings of the commission during a six month period of study and hearings. To reproduce it verbatim here would be impractical and unnecessary, as those of our readers who are interested in the details of specific sections will doubtless procure copies of their own. We therefore present the following excerpts, directly quoted, to provide a digest of those features that may be of the most general interest:

"It appears from all that we can discover of the record at home and abroad that nowhere else are passengers, mail, and goods carried with such regularity and speed, by day and by night, with such comfort and convenience to the user of the service on anything like so broad a network as that provided by our major airlines. It appears, on the other hand, that a considerable part of the nation's air transport system is running at a steady loss, and that operations cannot continue indefinitely under present conditions. . . . American naval aviation represents the finest adaptation of aircraft to the rôle of service as units of a fleet that the record of world experience can offer. . . . We do not believe that there is a finer military flying man in the world than the typical graduate of the Air Corps Training Center, and his capacities increase with increased Service experience."

Rarely does a single product of the Federal Printing Office contain the complete story of an industry's relationship to the United States Government. Such is the case, however, with the report of the Federal Aviation Commission. Between its unassuming covers this volume contains not only the record of the present state of the aviation business with respect to the government, but a chart upon which the future course of this relation may be based. We give here a much abbreviated version treating only the most vital issues which it discusses.

Air Transport

Air mail payments and sums paid in direct aid to be separated; air mail to be put on a flat pound-mileage basis with

in the actual postage revenue; a permanent commission to administer governmental payments, regulate competition through certificates of convenience and necessity; transport aviation to remain divorced from direct military reserve,—implications; experiments to be tried with reduced postage "airgrams"; foreign operations under American flag to be vigorously supported; last June's air mail law to be amended as emergency relief; commission to be subject to merger with other bodies for the regulation of transportation.

It should be the policy of the United States to maintain a position of world leadership in air transport . . . whereas in the winter of 1934 approximately 56 per cent of all the air transport service in the United States is being rendered with machines cruising at a speed of 160 m.p.h. or better, the latest available report from European countries shows but 33 machines out of a total of 616 owned by all European transport lines which were capable of cruising at better than 125 m.p.h. . . . we have had no difficulty in arriving at a united conviction that the American airlines as now constituted render a highly useful public service and that they should be maintained and kept upon a high plane of efficiency and of performance. . . . If we had limited our attention to the tabulation of current operating figures alone, it would have appeared that a problem hardly existed. . . . But when we proceeded to examine the financial structure that underlies the operation and makes its continuance possible, any such illusion was dispelled. . . . It would appear that costs can hardly go below 25 to 30 cents a mile without sacrifice of safety unless all pretense of maintaining a general transport service be abandoned and planes having no passenger accommodation and carrying mail alone be used, or unless advantage be taken of fortuitous opportunity to buy equipment second-hand at junk prices in a distress sale. Neither alternative commends itself to us as a desirable one. . . . It is then disturbing to find one contractor showing gross revenues from all sources in October of 17 cents per mile, while eight were running below 30 cents. . . To maintain a safe and efficient air transport system under existing conditions demands direct governmental aid. . . in the year 1933 the governments of eleven leading European countries gave to air transport a total of approximately $20,000,000 of direct financial aid. . . . The lines so aided flew during the year, a little more than half the mileage covered on United States domestic lines in the same period.

The postal service has always pioneered in the development and use of swifter transportation, by land, sea, or air, but in every instance there comes a point beyond which the postal interest can no longer be considered paramount. . . . If the government is to aid airlines now it must specify not only that they shall make proper provision for handling the mail and for meeting the needs of the Post Office, but that they shall provide at the same time a general transportation service properly meeting the public convenience . . . the air mail carriers should be compensated for actual service performed upon a basis of so-much-per-pound-carried-per-mile-flown, and the rate of payment should be so determined as to lie within the revenue received by the Post Office Department from the users of the service. . . . *The responsibility for determining where air lines should run with governmental assistance should be a governmental responsibility, and when the appropriate agency has taken its decision the net amounts paid to keep the service in operation would seem to be less subsidies to the airlines concerned than to the communities served.*

ACME

Colonel Lindbergh in executive session with the F.A.C. Members of the Commission from left to right are Jerome C. Hunsaker, Franklin H. Lane, Jr., Chairman Clark Howell, Edward P. Warner, Albert J. Berres. Col. J. Carroll Cone, secretary, is standing.

The award of direct governmental aid to private enterprise serving a public purpose is always a matter of great delicacy, and one requiring the most careful supervision. . . . *The need for a commission to deal with certain problems of aviation seems to us clear.* . . . Speed of regulatory action can only be attained through placing authority with a group that will specialize in this particular field until they acquire an understanding of its problems that will make repeated preliminary explanation of the fundamentals unnecessary. It cannot be attained by piling a new and highly specialized group of questions on top of an already crowded docket of quite a different order.

All regular domestic scheduled transport operations should require a certificate of convenience and necessity, . . . where a service of high quality exists, and where there is just enough traffic to justify its existence, it seems to us plainly destructive of the general welfare that a new operator should be permitted to appear on the same route with an inferior service and to wean traffic away from the established enterprise by rate-cutting. . . . To attempt to allocate the right to run lines through a process of competitive bidding is to throw undue emphasis on economy at the expense of quality. An airline cannot be casually torn up and transplanted. . . . We can see no way of introducing an adequately flexible control over a rapidly developing art unless the flexibility be extended to commission power to select operators for new routes and to determine from time to time the conditions under which they must render service.

The present high quality of American air transport is due in large part to the competitive spirit that has existed throughout its development. . . . To allow half a dozen air lines to eke out a hand-to-mouth existence where there is enough traffic to support one really first-class service and one alone would be a piece of folly. To try and maintain a multiplicity of services in such a case by giving direct governmental aid to all of them would be folly thrice compounded.

The Post Office Department can now take towards the airlines exactly the same attitude that it takes towards the railroads . . . all airlines that are maintaining regular service should be considered as common carriers available for the transport of mail. . . .

The direct financial aid given to air lines should be under the constant control of the commission, and subject at all times to revision as technical improvement, changes in operating conditions, or the needs of the particular territory served may require . . . a line on which the commercial revenues, including those from mail, cover materially less than half the operating costs should have to stand the most careful scrutiny as to its place on the national map and the social or economic purpose that it serves before the decision is taken that it should be kept in operation at governmental expense. . . . We believe that it is possible for a permanent commission to develop a suitable basis which will encourage technical progress and the improvement of operating methods, and at the same time eliminate wastefulness either in operating method or in type of service, reward extraordinary efficiency, maintain standards of safety, assure the building of adequate depreciation reserves, and eventually provide for a natural transition from a governmental-aid status to a purely commercial one, or the extinction of lines showing no apparent prospects of economic self-sufficiency.

We believe that all long-haul first-class mail could be put on the airlines in the United States without making the service show a direct loss to the government . . . we anticipate that the use of the speediest transport service available for all first-class communications will some day become the rule. To adopt air service for all first-class mail at present, however, would mean a sacrifice of a large part of the profit which the Post Office Department now makes on that class of mail. . . . We estimate the net cost to the government of abandoning air mail as a special class and

treating all first-class mail alike, using air transport wherever it would speed delivery, as about $30,000,000 per year.

Constant reports from Europe that the air transport systems of certain countries exist with a hidden military purpose and that the aircraft used on the airlines are in fact military machines under a thin veneer of commercial disguise have stirred American suggestions that we may be neglecting the interests of the national defense by not taking similar action here . . . we have given the matter consideration and we do not believe that either military or civil aviation would be helped by requiring any merger of the interests of the two in the equipment of either. . . .

There should be an increase of air transport service and ground facilities in Alaska.

American airlines virtually girdle South America. . . . We have had a wealth of evidence laid before us, including some gathered by our own members during an inspection trip, that they perform a useful service for American commerce and that they contribute notably to the development of good will towards the people of the United States . . . if there is to be air transport across the Atlantic or the Pacific or both it seems to us clear that America should have a share in the development . . . *we are sure that service by airplane across both the Atlantic and Pacific, making use only of the intermediate stopping-places that nature has provided, is reasonably near.* . . .

If American airlines are to compete with lines under foreign direction it would be an obvious absurdity to divide the American strength by competition among a multiplicity of American-flag enterprises. . . . The spur to progress that only competition can supply should be adequately furnished by the foreign competitor, coupled with the constant watchfulness of American governmental authorities over the standard of service rendered. . . .

Nationalism in the development of air commerce has to be reckoned with as a practical fact. We have no difficulty in arriving at the recommendation that this government should control airline development in accordance with the practice generally followed by its neighbors, and that whatever powers it posseses to grant or to withhold privileges desired by others should be used in the interest of securing proper opportunity for American enterprise abroad. . . . We particularly recommend that appropriate action be taken to oppose the exclusion of American air transport enterprises from any area serving as a necessary stopping place along a great intercontinental trade route.

As a measure of immediate emergency the present Air Mail Act should be amended so as to empower the Interstate Commerce Commission to revise existing air-mail rates either upward or downward as the facts may warrant. . . .

As the law now stands, it will be necessary before March 1st for United Air Lines to dispose of its route from Seattle to San Diego in order that it may retain its transcontinental route. . . . We have had laid before us an enormous number of protests against these requirements from civic and commercial organizations and from individual citizens of the areas affected . . . we cannot believe that any serious harm will be done by allowing the present arrangement of airlines to continue throughout the present year to permit of the perfecting of any permanent changes that may appear desirable in present legislation . . .

In dealing with a field in which government has on the one hand to exercise such minute and extended regulation, and on the other to supply such a variety of direct and indirect aids in order that development may continue, a great number of problems of a quasi-judicial nature inevitably arise. It is of the utmost importance that their treatment should be removed from every possibility of regional or factional influence. . . . Among commissions now existing the only possible repository for these responsibilities would be the Interstate Commerce Commission. . . . There would seem to us to be a great danger that through the placing of an additional burden upon an already heavily loaded agency delay might be caused where promptness and certainty of action are of the utmost importance, and that in the formative stage of a new regulatory doctrine there might be an inevitable feeling for analogies with other forms of transportation where such analogies may be superficially attractive but valid only in a very limited degree and actually misleading beyond that point. . . .

Private and miscellaneous flying

Department of Commerce to extend policy of underwriting development cost for private-owner types; fixed-base operators to be made eligible for R.F.C. funds; gliding and soaring to be studied by Army and Navy for use in training schools.

. . . *we accept it as logically apparent, that the greatest hope of building up a great aircraft industry to provide employment in peace and a reserve of manufacturing capacity for use in war lies in private ownership* . . . there is more private ownership of aircraft in the United States, unsubsidized and unstimulated as it is, than in all of Europe combined. Yet we are agreed that it ought to be possible to expect much more. In the expansion of private use lies the whole hope of the aerial service industry . . . Let private aircraft be sold in really substantial quantity, and the troubles of the fixed-base operators at some hundreds of airports will be at an end. . . . Demand can be discovered and developed with some governmental aid, and where potential demand and potential supply exist the government may assist in removing the barriers between them . . . the problem of high cost can only be met by increasing the volume of operation and so reducing the overhead . . . there is no economic magic that can be effected by governmental intervention . . . a handicap to private flying which lies outside governmental control is that most airports have been planned with primary reference to the commercial user and that a great many of them offer a minimum of convenience and satisfaction to those who fly for pleasure . . . the government's responsibility in regulating aviation lies first to the general public on the ground, second to the users of commercial air service, third to the purchasers of aeronautical products, and fourth to all the users of the navigable airspace in that they should be protected against each other's recklessness or misdeeds . . . beyond that point it is not the task of government to prevent any of its citizens from determining their own courses . . . further study should make it possible, for private pilots and for them alone, to reduce materially the degree of medical supervision now required and also to simplify the requirements relative to the inspection of their airplanes and to their own professional qualifications. . . .

The Department of Commerce should be authorized to make experimental purchases, by negotiation, of aircraft or other aeronautical equipment seeming to promise special advantages to civil aviation and not likely to be promptly developed otherwise . . . there is a widespread feeling that the great need in order that private flying may be extended is that it should be made easier.

. . . *Fixed-base aircraft operators should be made eligible for Reconstruction Finance Corporation loans upon proper security.* . . . They are in danger of encountering in local bankers an invincible lack of comprehension of the nature of the aviation business and of what would be done with money if it were provided. . . .

Gliding and soaring have struggled along in the United States without governmental support or interest, and under the handicap of various waves of ridiculously exaggerated promotion . . . gliders possess no miraculous properties, but they have a certain interest as instruments of research and of study of atmospheric conditions. They seem to have marked possibilities in simplifying the training of pilots. . . . We recommend that the Army and Navy study the usefulness of the glider as an instrument of training at their elementary schools.

Airports

Federal aid to cover new lighting installation at airports and a share of maintenance, on lighthouse analogy. Federal agencies to provide fields in recreational areas.

The necessity of maintaining an adequate airport system, if aviation is to have any chance of developing, seems to us too obvious to require argument. . . . A municipal airport can be considered as a public utility serving a community purpose, even though its fixed charges and a certain portion of its running expenses have to be met out of the general funds . . . many communities are clamoring for assistance in operating their fields, protesting that the Federal government ought to take them over, and even threatening to close them down completely unless some relief is given . . . we recognize the real gravity of the problem of airport economics, and we have given a great deal of thought to various proposals for Federal aid. . . . The provision of lights at airports appeals to us as presenting a perfectly valid analogy with the provision of harbor lights and buoys . . . we are proposing that the Federal government assume the responsibility for the installation cost of new lighting and for a part of the maintenance cost. . . .

Nothing would be more helpful in developing private flying . . . than a more general dispersion of airports in the places to which the private pilot might be expected to want to go.

National defense organization

G.H.Q. Air Force to be first step toward perfection of Air Corps in its independent functions. Army and Navy programs to be diminished in no way; Air Corps to increase experimental activities; encouragement to be extended toward the development of liquid-cooled engines above 1,000 hp. and of diesel types; Army and Navy engineering officers to study transport experience and practice; civilian repair stations to do occasional service work; Air Corps rankings to be made commensurate with duties performed on a temporary basis awaiting solution of seniority tangle; reserves to be doubled and increased flying allowed, some of it in ships

rented from commercial operators; airline pilots to be left in present jobs in event of war but to be enrolled in reserve; other civil pilots to be offered an abbreviated military training.

. . . aircraft have now passed far beyond their former position as useful auxiliaries, and must in the future be considered and utilized as an important means of exerting directly the will of the Commander in Chief . . . the projected G.H.Q. Air Force must be judged with reference to its effectiveness in this respect . . . there will be a progressively greater measure of independent action of aircraft in military operation as the capacities of aircraft increase. We interpret the present proposals as a step towards provision for such increased independence. . .

The military air forces of the world, almost without exception, are in process of rapid expansion or of more or less complete re-equipment and modernization to secure increased power. Earnestly as that process may be deplored, it has to be reckoned with as a fact. . . . While we are laggard neither in numbers of aircraft nor in their general quality at the present time, we might easily become so if we fail to accept the lessons of the current policies of other Powers. The Navy has a program calling for 1,910 airplanes to be in service by 1941. The War Department has plans for a program that calls for 2,320 planes by 1938. Nothing short of a radical change in the international situation should be allowed to interfere with the completion of these programs. . . . Long before their completion they may call for further modification. . . . The nature and common disposition has been to concentrate a substantial proportion of the aerial operations of the Army and Navy in regions where climatic and geographical factors and simplicity of supply problems permitted continuous operation at high intensity. No such selective principle operates upon the determination of a theater of war . . . we wish to express our special commendation of the experimental operations of the Army and Navy in Alaska, and to endorse the recommendation of the Baker Board that military air operations in that territory should be put on a year-round basis on a substantial scale. . . . Officers of the Army Air Corps have pioneered in extraordinary developments in instrument flying, and especially in the development of blind-landing systems and technique. We urge that the Services carry on diligently with research in that field, and at the same time proceed to make full and rapid practical application.

Instead of spending too much on experiment and development, the Services seem likely to spend too little, for it is upon current experimental appropriations and upon the wisdom with which they are expended that the quality of our aircraft of a few years hence will depend. The past year has been marked by incessant attack, using every available medium of publicity, upon the quality of American military aircraft. Some of the statements made almost advertise upon their face their own intemperateness and exaggeration . . . these charges seem to be essentially similar to those being made at the same time in the very countries which have been held up to the United States as examples to imitate. . . . The tabulation of comparative figures on the aircraft of various nations is a futile pursuit in which we have declined to engage. The nations of the world do not habitually publish correct data on their latest military aircraft, and we have had ample evidence that the figures that creep into print are frequently far from correct. . . . American military planes powered with American engines seem on the whole, surveying the entire range of types required, to be as good as any that exist elsewhere. In some respects and in some particular types they appear quite beyond challenge. . . . That American engines of from 200 to 750 hp. or thereabouts are at least the equal of any others in the world in reliability, economy of first cost and of operation, and general serviceability seems to be beyond question . . . engines of American design (and in many cases built in American factories) were in use on 14 per cent of all the aircraft in service on European air lines in the spring of 1934. . . . There is a real need for high-performance engines of 1,000 horsepower or more. . . . We recommend that such a development be given the highest possible priority . . . the initial spur for the drive toward high-powered liquid-cooled engines that has occupied European governments and industries for the last eight years was applied by the United States. . . . In the introduction of supercharging, too, the United States pioneered . . . there appears to have been an excessive emphasis on building the whole equipment into the normal structure of the engine and avoiding any additional mechanism. . . . The diesel type of engine also found its first successful aeronautical application in America . . . the military and Naval Services have shown somewhat less interest than would have been appropriate.

. . . there is a fundamental difference between transport and military flying which convinces us that they should be kept quite separate in administration. . . . It has been proposed that Army and Navy pilots should serve as co-pilots on airlines. That appears to us so undesirable from both civil and military points of view as to be virtually unworkable . . . it ought to be of marked advantage to detail half a dozen experienced engineering officers from each Service to devote a few months to an intensive study of airline maintenance bases. A limited number of officers might properly fly as guest pilots on transport lines.

. . . It should be possible in many instances to arrange with advantage to have civil service stations do mechanical work on Service planes and engines . . . the quality of the work done by the best civil repair stations is quite in the same class with that of the Army and Navy shops.

The promotion status of officers of the Air Corps is unsatisfactory and destructive of morale . . . temporary promotion to ranks commensurate with the duty currently performed should be made an accepted principle for general application in the Air Corps . . . the commanding officer of the General Headquarters Air Force should be chosen from among all the colonels and lieutenant colonels upon the Air Corps list . . . there should be freedom to select the one of that group best qualified to exercise the supreme field command of the Air Corps, and the appointment should carry with it temporary rank as a Major General. . . .

It has been common experience that airplanes should be commanded by commissioned officers . . . there is an abnormally large need for officers in the lower ranks of aviation . . . it is desirable that such ranks as that of major and lieutenant colonel be reached by men still young enough to fly actively and well . . . only a little over 25 per cent of Annapolis graduates can qualify for aviation duty. . . . That is not enough to meet the demand of the Service. . . . The only recourse then seems to be the short-service commission or its equivalent . . . a three-year term after graduation from the Service flying schools is now under consideration. . . . Our own inclination is to look with favor on an authorization for a maximum of as much as four or five years of active duty after graduation from flying school. The typical Reservist would then be returning to civil life, in the number of about 200 per year from each Service, approximately at the age of 28 and with over 1,000 hours of difficult and disciplined flying to his credit.

In war against a major Power our air forces would feel an almost instant need for the mobilization of at least twice, and in the Army probably at least three or four times, their regular personnel. . . . The funds for Air Corps Reserve flying operations seem to have been spread so thinly that a large number of men have received a very small amount of flying practice and still less training of a truly military nature . . . the most urgent concern must be with the first-line group that stands ready to step directly into tactical organizations on the day of a declaration of war . . . it seems to us conservative to say that the aggregate of effective air force Reserves should be at least double what it is now . . . A considerable part of the practice flying time might be taken, at least by the second-line Reserve, in light civil aircraft rented from commercial operators. . . . Flying under those conditions ought to cost less than one-third as much per hour as we are told it now costs to operate Army aircraft for the Reserve.

. . . The personnel organizations of the domestic air transport lines should be left largely undisturbed in the event of war, the need for transport pilots being greater on the routes to which they have been trained than in any military service into which they might be inducted . . . we would think it desirable that even those who were sure to be needed in their present transport positions should be enrolled in the Reserve.

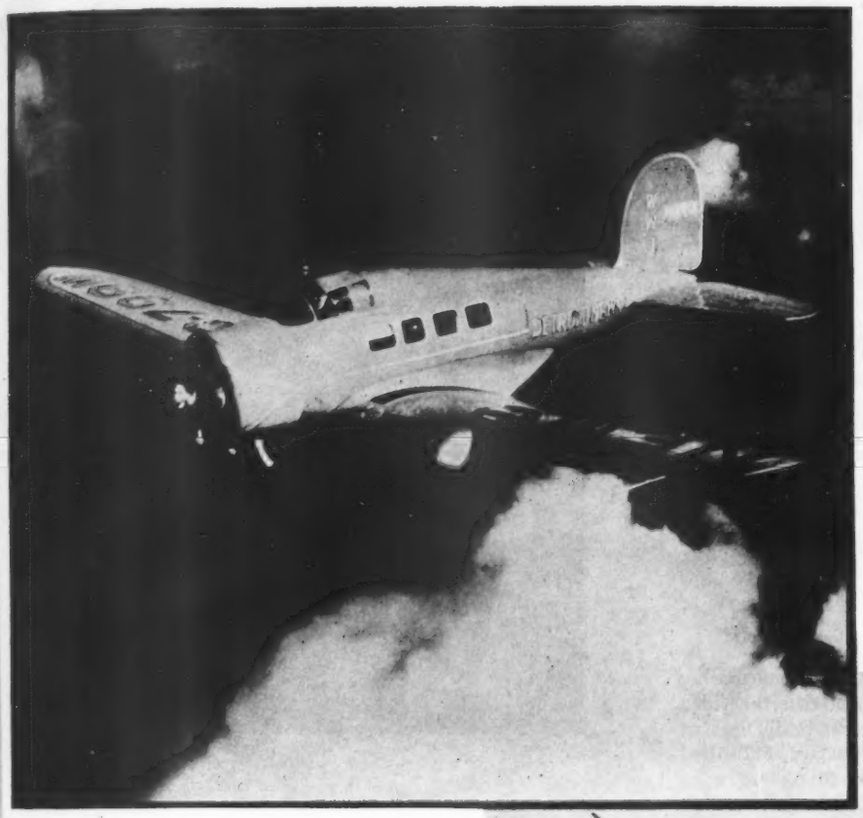
. . . Some record should be made of the capacity and the military availability of the 10,000 or more American civil pilots not employed in air transport. . . . We suggest that courses be now developed to take men who have already shown that they know how to fly and to give them, in the shortest possible period of time, the particular things that they lack to make them into military or naval aviators qualified for immediate war service.

Government and industry

Control of civil aircraft design and construction to continue present satisfactory status; approved type certificates to carry performance statement; reciprocal agreements with foreign countries to facilitate export of civil aircraft to be promoted.

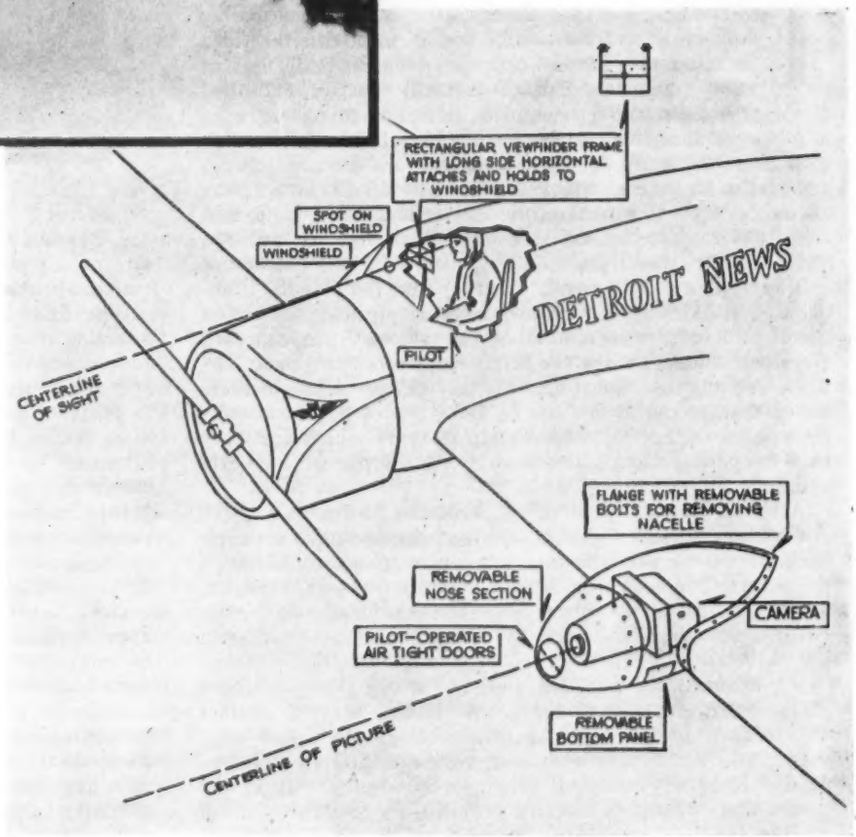
The control of civil aircraft design and construction by the Department of Commerce since 1926 has promoted a very high standard of safety and reliability in American civil aircraft . . . we have been greatly impressed by the extraordinary qualifications of the technical personnel of the Bureau of Air Commerce, and especially of the engineering inspectors and engineering test pilots . . . we believe that all governmental regulation should be held to the minimum compatible with public interest. . . . *The record of governmental control in America has been so good, and its administration has been so sympathetic to the industry's problems and so free from bureaucratic rigidity, that we believe there*

(Continued on page 56)



News Hawks Aloft

The Detroit News breaks more new ground in the application of advanced aeronautical equipment to the needs of a large metropolitan newspaper.



THERE are probably any number of journalistic features by which the Detroit *News* is known to its readers, but even if all its reporters were authors of best-selling novels it would still be known to the aeronautical industry for its constant and aggressive use of aircraft.

It's no new fad with the Detroit *News*. William E. Scripps, now president of the *News*, piloted the first delivery of newspapers in the Detroit district in 1912, and the use of planes in publicity deliveries, in photography, in news coverage has been a constant policy of the paper ever since. It bought one of the first of the big Pitcairn giros. Now it announces the purchase of what can best be described as a super answer to a demon reporter's prayers, a Lockheed Altair equipped with three types of camera, complete radio, typewriter desk, Sperry giropilot, and a host of instruments for all-weather flying.

The plane is powered with a 550 hp. Wasp and is equipped with Hamilton-Standard controllable pitch propeller and wing flaps. Its speed ranges from 65 to well over 200 m.p.h. It can carry four persons or a half ton of newspapers in addition to the pilot.

The radio installation, specially designed for the purpose and built by Western Electric, will have a receiving coverage from 195 to 6,000 kilocycles, a broadcasting range from 1,000 to 6,000 kilocycles. In addition to regular navigation uses it is planned to serve as a pick-up station for "eye witness accounts" or news flashes to be rebroadcasted through WWJ.

The photographic installation is indeed unique. In a compartment at the rear of the cabin provision has been made for an ordinary manually operated camera to be directed upward, to either side, or toward the rear. A second, located in the cabin itself, is directed vertically downward, and can be operated either manually or through automatic control from the pilot's cockpit. The third, housed in a special nacelle on the left wing, is eight feet out from the cabin. Fully automatic its direction is the same as the airplane's. The pilot lines a sight at the object he wishes to photograph, pulls a trigger. The camera, a modification of the Fairchild oblique type, driven by a small electric motor, does the rest.

Woe betide a cub returning empty-handed from an assignment in this craft.

The 1934 Paris Salon

American products were notably absent, but their influence was plainly evident in many designs.

By Dr. Alois Robert Böhm

AVIATION'S *Paris Correspondent*

ACME

THE history of the Paris Salon is, in a sense, the history of aviation itself, and it was with this idea in mind that M. Granet, who organized the first of these expositions in 1909 and still is active, exhibited at this, the fourteenth, a complete collection of photographs of all previous shows. It has been traditional in these shows to present a picture of world aviation in a French setting, and the most recent, which closed early in December was no exception. It is, therefore, extremely unfortunate that the American aeronautic industry, which has so much to show Europe, was represented by such a limited number of exhibits. Only the Pratt & Whitney and the Bendix Companies had exhibits and visitors were deeply disappointed at the absence of representation of the famous American civil airplanes, some of which are being operated on European airlines, and the new American military types. It is sincerely hoped that, at the next show in 1936, it will be possible for Europeans to see the latest American types which are more than ever before necessary to complete the picture of world aviation.

After visiting the 1934 Salon, it cannot be denied that the American methods of design and manufacture have a strong influence on the products of European constructors; although the reverse has been true in former years. Martin, Douglas, Lockheed and many other manufacturers would have discovered that their technique has found great appreciation in the old world.

For example, the Breguet "Fulgur," which greeted visitors at the main entrance of the Grand Palais, bears a distinct resemblance to the Douglas transport. It is a low-wing monoplane with retractable undercarriage, and two Gnome Rhone K-14 supercharged and geared engines. It is expected that, when this machine is flown, its performance will be equal to that of the best American twin engined commercial planes. A strong resemblance to the Lockheed Electra was noted in the Monocoque exhibited by the Bristol Company of England.

Welding becoming more popular

Welding appears to be more common in aircraft construction and the shotwelded structure of a high-winged plane was included in the very extensive exhibit of the U.S.S.R. Compared with the Russian exhibit shown six years ago in Berlin, the Soviet aircraft and engine industry has made remarkable progress. Russian construction did not appear extraordinary, but the method of manufacturing and of controlling material and fabricating methods have reached a very high level. Judging from the development of Russian aeronautics, on the basis of this exhibit, it is apparent that the Russian designer should now be able to attack highly advanced problems without being limited by insufficient materials and untrained and inexperienced workmen.

The Budd welding method was not only exhibited at the stand of the French Budd Company but also among the Italian exhibits was a Savoia Marchetti amphibian, constructed by the Budd-Shotweld process.

In general the Paris Salon of 1934 confirms the impression of the 1932 exposition that low-wing monoplane construction is making rapid progress and that this type of machine is preferred not only for civil but for military airplanes. Even the British designers are inclining more and more to this formula.

Metal construction including metal covering of wings and fuselages showed wider application. The materials used are mainly light alloys of the duralumin type, but sheet steel appears to be attracting the interest of the designer. The use of magnesium alloys and particularly of magnesium castings for wheels, brakes, and shock absorber frames, as well as other accessories, has ceased to be news. But in engine construction the use of these alloys has become more and more common and the exhibition of light alloy foundries indicated that this practice has reached a high degree of perfection, particularly in Great Britain.

Engine development of recent years tends toward the air-cooled types of power plants and the accomplishments of such manufacturers as Gnome-Rhone, Curtiss-Wright, Pratt & Whitney, Bristol, Salmson, Walter, and Armstrong, have made it difficult for the water or liquid-cooled types to follow. The sleeve-valve construction used in the Bristol is a marked improvement and the reduced frontal area, combined with N.A.C.A. or Townend ring cowling has contributed substantially to aero-dynamic progress. That a firm like Hispano is now making the Wright engine, that Napier exhibited 6-, 16- and 24-cyl. air-cooled types, and Lorraine is making air-cooled engines, indicates impressively the actual situation. Makers of liquid-cooled engines such as Hispano and Lorraine are also progressing and the Fiat

KEYSTONE

As Seen by an American

Like a small boy showing off his muscle, each nation proudly displayed its military air strength.

By Rex Martin

Assistant Director of Air Commerce

THE Fourteenth International Aeronautical Exposition held in the Grand Palais in Paris Nov. 16 to Dec. 2, 1934, would have interested any American.

What was shown there at once confirmed and denied the various things about European aviation that are popular current thoughts of Americans who think in terms of aviation. The show was opened by the President of France, not by pushing a button but by personal minute examination of every exhibit in the building, for the French are always polite. He was flanked by the heads of military and naval aviation, and attended by the leaders of civil aviation, plus the American, British and other ambassadors, each with their military, naval and commercial aides. Those who had no military uniforms wore formal morning dress. All in all aviation in Europe carries dignity as well as interest.

The French exhibits, which quite naturally dominated the exposition, were arranged in the center of the salon on the main floor. These were surrounded by German, British, Polish, Czechoslovakian, Russian, and Italian displays. Without exception the most outstanding equipment of each nation was that designed primarily for war use.

I do not recall, in my many years of attendance of similar expositions in America, ever seeing more than one or two military airplanes, and those were in no way the outstanding planes in the show. As I looked about I gained the impression that each nation was primarily interested in showing its military prowess, something after the fashion of the small boy exhibiting the size of his muscle. For those who would question this impression permit me to point out that machine guns are not mounted on commercial aircraft, and these were in great evidence. Moreover out of 68 planes in the show there were but seven transport planes shown. Of nine seaplanes, only two were of the transport type, while three were definitely military.

Among the small transports the most outstanding in my opinion was the German Heinkel He-70, in which I had the good fortune to fly over a great part of Germany. The measured top speed is 234 m.p.h.

In number the touring planes was the largest in the exhibition. All were fitted with devices of various kinds to increase lift and maintain control beyond stalling speeds. The inverted in-line, air-cooled motor had the call so far as power plants were concerned, and a great many two-engined light planes were shown. This is a development which American designers could well-afford to consider for the private user of the airplane. I personally would prefer the safety of sustained flight on one motor of small horse-

and Isotta 1,000-hp. water-cooled types are truly remarkable. The Rolls-Royce evaporation cooled "Kestrel" is unquestionably a masterpiece.

Diesel design noteworthy

Diesel engine progress is also noticeable. The water-cooled, two-piston type Junkers Jumo IV and V is now in regular service in Germany, manufactured under license in France by the Compagnie Lilloise des Moteurs and by Napier in England. Isotta-Fraschini showed an Asso 200 hp., 6-cyl., in-line engine which operates on gas, oil or gasoline by the use of the Bagnuli-Brandt culasse. The air-cooled engines of the diesel type also seemed to hold promise and the Clerget reversible radial diesel of 600 hp. shown by the French Air Ministry has performed very satisfactorily on test flights. Salmson showed a radial air-cooled diesel of 650 to 700 hp. It is unfortunate that the achievement of the Packard diesel in America was so suddenly interrupted by the death of Captain Woolson, its designer.

A great deal of importance is being attached to variable pitch propellers. The Hamilton-Standard, manufactured in France by Hispano, and the Ratier are regarded as the most approved designs. The question of wood or metal blades has not been decided and the Schwartz system of protecting wooden blades by a Bakelite sheathing has opened new possibilities for wood in propeller blade construction. This process also has been used on the leading edges of the wings of the Heinkel high-speed, low-wing Sperber for four passengers, which had one of the most interesting structures at the Paris show.

The three-engine Junkers J-52 on floats, largest among the exhibited planes, dominated the show by its size. Tremendous popular interest was drawn to the exhibit of the old fabric-covered wooden biplane which was used in rescuing the people marooned at Tscheljuskin and a copy of the sphere of the balloon in which Prokowiew reached 19,000 m. Another point of interest was the Macchi-Costaldi low-wing plane with 3,100 hp. Fiat engine in which the Italian pilot Agello established the world's speed record of 709,209 km.

power in the event of the failure of the second motor, rather than risk the possibility of major damage to the ship in a forced landing on unsuitable terrain in the event of the failure of a single-engine. The other advantages of motors faired into the wings instead of the nose are too obvious to require detailed discussion here.

In the engine exhibits America was represented by Pratt & Whitney, who also showed the Hamilton Standard controllable-pitch propeller. The exhibit attracted more than the usually allotted time of inspection by the president of France. Of outstanding interest to me, however, were the heavy-oil engines. Junkers displayed three Juno-5 engines mounted in a seaplane. Napier and Lilloise showed engines licensed under the Junkers patents. The Salmson Company exhibited a 9-cyl. two-stroke Diesel and the French Air Ministry showed a 500-hp. 14-cyl. radial power plant.

In my opinion it would be well for America to pursue the possibility offered by this type of engine. Several transport Diesel equipped planes are in daily use by the Lufthansa in Germany.

Engines of 1,000 hp. and up in the liquid-cooled type were shown. A talk with several of the leading manufacturers of this type of motor carries considerable conviction of the necessity for giving the liquid-cooled motor more attention in America, especially for high altitude work.

The second-floor galleries displayed aviation accessories. Rooms to the side housed exhibits by the Air Ministry designed to show the progress of aviation. This was most interesting. To complete the war picture, a series of dioramas depicted the invasion of France by air. Ruins of the Place de l'Opera were reproduced with telling effect on the minds of the on-looker, and if such pictures should by any chance fail to carry conviction of the efficacy of an attack by air, one had only to read the directions for the use of gas masks and shelters in the event of a raid, to realize how helpless the unprotected can be at such a time.

Yes! America leads the world in commercial aviation. Why? The answer is given in the guns mounted in aircraft displayed in an International Aeronautical Exposition held in Europe.

Quotes from the Aviation Commission

(Continued from page 52)

would be universal regret if it were to be abandoned.

. . . The responsible manufacturer who is conservative in his claims of performance may find himself in competition with less responsible or more enthusiastic rivals whose performance figures may represent rather hope than measurement. . . . We suggest that the examination of a new type of aircraft for its approved type certificate should include a measurement of the most essential elements of performance.

***The military associations of aircraft manufacture have resulted in laying extraordinary limitations upon foreign trade even in the most purely commercial airplanes* . . . The purchase by a subject of a European state of an American airplane for private use has been attended with practically insuperable difficulties . . . there has been a growing appreciation among the major Powers of the undesirability of this particular form of industrial autarchy through regulation, and a growing willingness to allow international trade on a reciprocal basis. . . . We urge that every effort should be made to arrive at suitable agreements with all countries of the world to permit of a free sale of commercial aircraft.**

Research and education

N.A.C.A. to be left undisturbed in leadership of research; to be granted enlarged appropriations; universities and school research staffs to be organized into national plan.

Upon no subject on which we have received testimony and correspondence has there been a closer approach to unanimity than upon the work of the National Advisory Committee for Aeronautics . . . it is given credit for the features most largely responsible for the present spectacular performances of American transport planes . . . *we recommend that it be left in undisturbed possession of the field.* This appears to be in full accord with the desires of all government departments concerned with aviation. . . . We are suggesting that the Advisory Committee broaden its plan of auxiliary organizations somewhat to include a larger and more frequent participation by the aircraft industry.

New ideas and advances in science cannot be predicted. . . . The scientific staffs and research workers of American universities and technical schools should be a source of useful research effort in areonautics . . . some arrangement should be made for drawing suitably equipped institutional laboratories and qualified members of their staffs into the framework of a national plan . . . We recommend that the Advisory Committee have an appropriation for the support of specific research projects approved as likely to offer useful contributions to aeronautical knowledge.

Governmental organization

Control to be vested in personnel of utmost impartiality and disinterestedness; to be ensured of sufficient tenure of office to justify highest professional qualifications.

It is of manifest importance that the work of technical supervision and regulation of aeronautics should be in the hands of personnel of the greatest professional expertness and of the most utter impartiality and disinterestedness . . . the stability of the individual's connection and the provision of an attractive and secure career for the professionally competent ought to become the major objective for good future performance . . . all those in immediate contact with such work should have all possible assurance that the continuance of their employment and their chances for promotion depend exclusively upon the competence with which they perform their duties.

Aeronautical law

Substantially uniform state laws to be urged and a Constitutional amendment put through if necessary; Air Commerce Act of 1926 to be amended to provide for recording of aircraft titles and mortgages.

If aviation is to escape such harmful effects of conflicting state legislation as have hampered for 30 years every attempt to secure a uniform control of traffic on the highways, state aeronautical regulatory laws must be substantially uniform. . . . If the completion of this movement for uniformity should be unduly delayed a Federal constitutional amendment should be adopted.

A new form of law is of necessity being created overnight, to take the place in the air that admiralty has been gradually developed through centuries to take upon the sea. The United States ought not to be absent from the preliminary councils of its creation.

. . . It is recommended that the Air Commerce act of 1926 be so amended as to provide where possible for the recording of title to aircraft and for the recording of mortgages and/or other liens upon aircraft.

Procurement, et al.

Policy to recognize need for adequate peace time force, for production facilities to meet war time expansion; to avoid tendencies toward obsoleteness in craft in current use; quality rather than price to be considered prime consideration; all departments procuring aircraft to follow as uniform a procedure as possible; development of new types to continue to be provided by design competition and experimental contracts for specific articles but rules to be modified to permit flexibility; Navy and Air Corps to institute competitions for confidential designs among qualified manufacturers; construction royalties to be provided in cases when construction contract is awarded to other than original designer; Secretaries of War and Navy to be explicitly granted authority to place contracts by negotiation subject to the requirement that a full report of each transaction be made to Congress; profit limitation to be applied over substantial period rather than to specific contracts; Army and Navy industrial mobilization plans to be pressed.

Personnel to be allowed further opportunities to specialize in aviation duty; aviation specialists from Naval Reserve to be eligible for direct entrance into Coast Guard; Coast Guard to procure equipment through Navy.

A training airship to be built for the Navy to replace the Los Angeles; an airship for transoceanic commercial service to be built with government funds and leased to operating company; the production of helium to continue under Bureau of Mines; sale and export of excess helium to be subject to approval of aviation commission.

The Future of Cruising Control

Development and refinements to come. The eleventh article in a series on operation at desired cruising conditions.

By Edmund T. Allen and W. Bailey Oswald

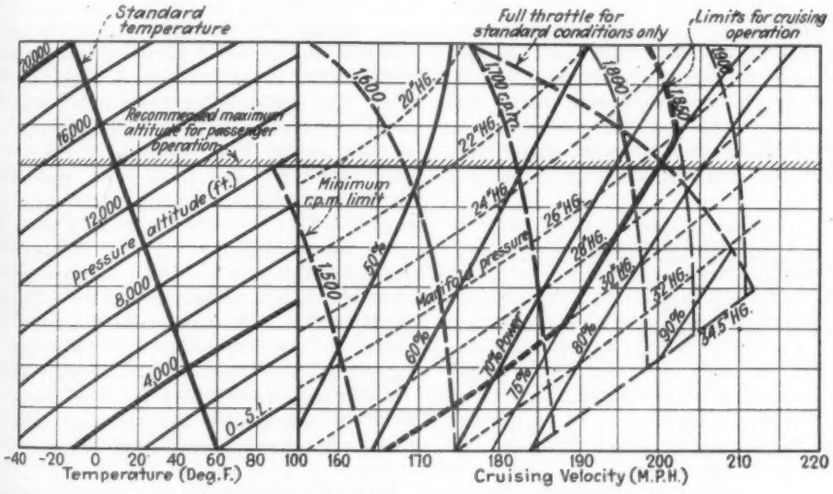


Fig. 55: Combination cruising chart showing velocity vs. altitude for various constant values of the engine characteristics: Percentage of rated power, revolutions, and intake manifold pressure. This chart is based on flight test data of several production airplanes corrected to the design gross weight. (Douglas DC-2. Gross weight, 18,000 lb. Two Wright Cyclone SGR-1820-F-3 engines. Hamilton Std. controllable-pitch propellers design No. 6111 set in high pitch at 34.5 deg. at 42-in. radius, diameter 11.0 ft.).

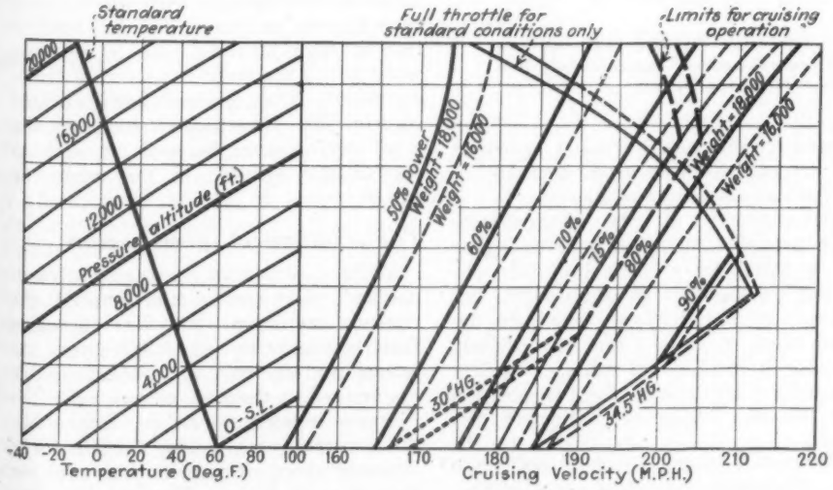


Fig. 56: Chart showing effect of change in weight upon cruising velocity at various altitudes and percentages of rated engine power. (Douglas DC-2).

THE CONTROL of the airplane in all portions of the cruising flight for maintaining a schedule under varied atmospheric conditions and over various types of scheduled trips has been fully outlined. It has been shown that a high degree of cruising performance can be obtained within limits that are most favorable to the engine and airplane, and that the desired cruising conditions can be readily established by the operation of controls and instruments according to information contained on "cruising" and "operation" charts.

The treatment has dealt specifically with airplanes of modern aerodynamic design equipped with two-position, controllable-pitch type propellers and engines of moderate supercharging capacity, since this type of equipment is in present use on airlines. While it is fairly obvious that the underlying principles of cruising control will be applicable to future types of design, it is nevertheless of interest to investigate briefly the effects of developments that seem certain to be incorporated because of unquestionable advantages offered by them. Constant-speed propellers and highly-supercharged engines are even at present under experimental development and flight testing. Knowledge of the influence of these innovations on cruising performance and control is necessary before the pilot and operating personnel can gain full benefit from them. Since the effects of weight changes are considerable, correction must be made where greatest accuracy is desired. The results of a study of performance changes caused by weight variation are presented later.

The flight test results in level cruising flight for a number of production airplanes have been analyzed, corrected, and averaged to obtain a cruising chart applicable to all models of this type.

Analytical correction has been made where the weight was other than the design gross weight of the airplane; so that the resulting chart represents cruising performance at the design gross weight. Fig. 55 represents this complete level flight cruising chart in which is shown the dependence of cruising speed upon the engine characteristics: power, revolutions, and intake manifold pressure. Fig. 55 is the same as Fig. 28 (AVIATION, October, 1934) except that the location and direction of the various lines are slightly changed. The significance of Fig. 55 is assumed to be known, since Fig. 28 was fully described in the article just cited. A cruising chart for the full design gross weight is desirable for establishing guaranteed performances, which are almost invariably specified at the design gross weight. Flight test results have proven that cruising velocity at a given engine power is in fact more definite than the maximum velocity, and easily determined; consequently, specifications for guaranteed performances now usually state cruising performances to the exclusion of maximum velocity.

Velocity-weight variation

Cruising velocity increases as gross weight decreases. The change is smallest at the lower altitudes and higher velocities, and increases as altitude increases and velocity decreases. The cruising chart for the design gross weight is generally considered satisfactory where the weight does not change more than about 15 per cent during a flight, principally because the small error resulting is a conservative one. The magnitude of the correction of velocity is illustrated in Fig. 56, in which there is plotted the cruising velocity for various percentages of rated engine power for the full design gross weight and an 11 per cent reduction in weight. The velocity at 75 per cent power is increased 2 m.p.h. at sea level and 3 m.p.h. at 14,000 ft., while at 50 per cent power the increases in speed at sea level and 14,000 ft. are 3 and 4 m.p.h., respectively.

While not strictly correct, it has been demonstrated that for the usual higher cruising speeds, the engine revolutions and manifold pressure curves on the cruising chart move forward approximately the same amount as the per cent power lines when the weight is reduced. If control is guided by engine revolutions or manifold pressure, the same cruising power will be maintained at an increased velocity as the weight decreases through fuel consumption; if, however, control is guided by indicated velocity, constant cruising velocity may be maintained at slightly reduced power, r.p.m., and manifold pressure.

Weight during flight

When a change in weight occurring during flight justifies making corrections, it is recommended that a cruising calibration flight be carried out at two extreme weight conditions. The correction can be calculated, however, if it is found impossible to make the flight tests. One should not overlook the possibility of obtaining data on regular flights. For this reason there is little excuse for not having complete information if one is willing simply to record and plot the data.

The climb and descent are considerably affected by changes in weight. Usually the climb is made with weight sufficiently close to the design gross weight that no correction need be applied. The descent, which is less affected by weight variation, needs no correction except for extreme changes. Flight tests are recommended where correction is justified, although the increased climb and decreased speed in the descent resulting from decrease in weight can be computed closely.

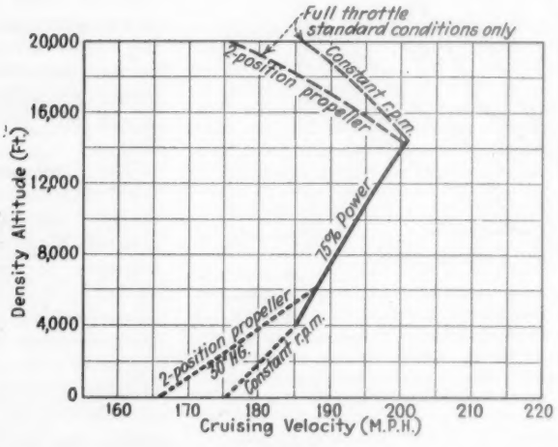


Fig. 57: Comparison of limiting cruising performances with two-position and constant-speed controllable pitch propellers. (Douglas DC-2).

Development of the controllable-pitch propeller has been progressing at a rate which leaves little time for pondering on methods of application, but rather requires that one anticipate desired types of control and immediately prepare to make use of them. Propeller control is passing from the two-position type which, except for alternate settings, is no more complicated to the pilot than the non-adjustable fixed-pitch type; through the multi-position type which would add complications necessitating control of pitch setting in addition to the control of engine revolutions; and, finally, on to the constant-speed (multi-position) type of control, which, from the standpoint of piloting, is similar to the two-position type, except that pitch setting is controlled rather than engine revolutions. The cruising and maximum engine r.p.m. settings correspond roughly to the high and low-pitch settings of the two-position type of propeller.

Constant speed propellers

The advantage of the constant-speed propeller over the two-position type lies chiefly in reduced engine wear and increased reliability, rather than any large increase in cruising performance. Maintaining the engine revolutions at the cruising limit assures that the manifold pressure, hence brake mean effective pressure, is at its lowest possible value. The importance of reducing manifold pressure was carefully pointed out in earlier articles, in which it was stated that it is almost invariably preferable that engine revolutions rather than manifold pressure be permitted to exceed limits, if an excess is unavoidable. The low-pitch cruising climb was therefore recommended for the purpose of maintaining low manifold pressure and avoiding low revolution speeds which tend to set up resonant vibration periods. The restricted manifold pressure limit reduces the sea level cruising velocity and r.p.m. for the two-position propeller to values uncomfortably close to the critical vibration speeds, as reference to the low-revolution limit on Fig. 55 shows. Reduced revolutions at low cruising speed, and in high-pitch climb at low power outputs, are adjusted by the constant-speed type of propeller.

From the standpoint of cruising performance the main advantage of the constant-speed propeller is the fact that the manifold pressure limit at low altitude is moved forward about 10 m.p.h. at sea level and correspondingly less up to its intersection with the cruising limit for engine power. The full throttle line at high altitudes also moves forward above the point for limiting cruising power. These changes are illustrated in Fig. 57. The improvement in sea level performance becomes greater as the critical altitude of the engine is raised.

The economical speed region

When cruising in the region of economical (fuel consumption) speed, the constant-revolution propeller increases fuel consumption and decreases the propulsive efficiency if revolutions are maintained at their maximum value. It is recommended, therefore, that either the constant-pitch setting or a reduced constant speed of propeller be used for this type of flight. However, for the usual higher cruising speeds, the constant-speed propeller causes no appre-

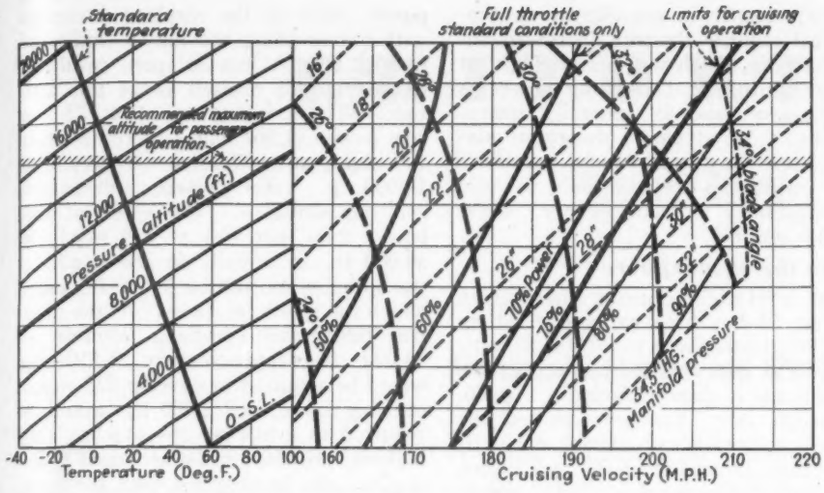


Fig. 58: Combination cruising chart showing velocity vs. altitude for various constant values of percentage of rated power, propeller blade angle at .75 R, and intake manifold pressure. Blade angle settings have been determined analytically to illustrate the general type of variation. (Douglas DC-2. Gross weight, 18,000 lb. Two Wright Cyclone SGR-1820-F3 engines. Constant speed propellers, 1,850 r.p.m., diameter, 11.0 ft.)

ciable reduction in propulsive efficiency or substantial increase in fuel consumption.

Performance in the cruising climb remains practically unchanged, except that an unlimited range in climbing speeds becomes available without danger of over-reving the engine. The cruising-power descent is affected at low and high altitude limits in much the same manner as the level-flight cruising limits are changed. In cases where moderate high-pitch setting has been used (instead of the high-pitch cruising setting as recommended) a large increase in velocity during the descent at the higher altitudes results since it becomes no longer necessary to reduce power in order to avoid exceeding cruising r.p.m. limits. Reference to Fig. 35 and 36 for the cruising climb and Fig. 37 and 38 for the cruising power descent (AVIATION, November, 1934) will aid in visualizing the changes resulting from constant-speed propeller pitch control.

Blade angle a guide

A level-flight cruising chart with constant-speed propeller is plotted in Fig. 58. By comparison with Fig. 55, it is seen that the general character of the chart is unchanged, except that the limits have been modified as previously described, that the manifold pressure lines have been steepened and moved forward as the result of the increased revolutions at lower speeds and lower altitudes, and that various constant blade angle lines (which have been estimated to illustrate the general nature of the chart) replace the various constant r.p.m. lines. Where engine revolutions formerly increased, pitch setting now increases to maintain constant r.p.m. It becomes immediately apparent therefore that the blade angle becomes a cruising guide analogous to r.p.m. on earlier charts. The cruising control chart with blade angle as the guide might well be mistaken for the former cruising control chart using r.p.m. This chart is shown in the chart, Fig. 59.

Either pitch setting, manifold pressure, or indicated velocity can be used to control the cruising speed and power in level flight. The advantages and disadvantages of controlling the flight by each of these characteristics are the same as previously discussed at length for the two-position propeller regarding, respectively, r.p.m. manifold pressure, or indicated velocity. (AVIATION, October, 1934.) Likewise the cruising climb and descent with constant-speed propellers can be controlled either by blade angle and indicated velocity, or manifold pressure and indicated velocity, in a manner analogous to that previously described.

Since r.p.m. has found the widest use as the guide with two-position propellers, it is believed that propeller pitch setting should become the accepted guide to be used with the constant-speed propeller. The principal point in its favor is the fact that the density altitude determines both blade angle and per cent power, and a given blade angle setting gives a certain airspeed regardless of the operating condition of the engine. The chief disadvantage is that the pilot must in addition watch the manifold pressure gage in order to prevent exceeding specified engine limits. The reader is referred to AVIATION, October and November, 1934, for a study of the various types of control. In level cruising flight the pilot adjusts the throttle until the blade angle becomes the required value, when it is known that the airspeed has reached the desired magnitude. The 75 per cent (or other) power cruising climb and cruising-power descent at 400 ft. per minute (or other rate) are controlled by flying at the required indicated velocity and adjusting the throttle until the blade angle reaches the necessary value; then the given speed and rate are established.

Pitch indicator needed

Briefly, it may be stated that both methods of, and charts for, control with constant-speed propellers are exactly analogous to those outlined for two-position propellers except that pitch setting replaces r.p.m. An instrument indicating propeller pitch setting is needed. The significance of this blade angle indicator becomes more fully appreciated when it is realized that the tachometers can be entirely dispensed with (assuming, of course, that the

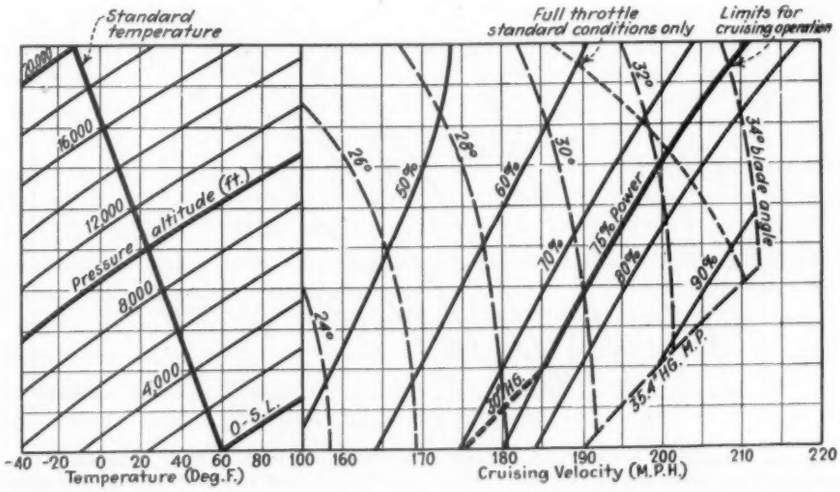


Fig. 59: Control of cruising by blade angle at .75 R. Chart shows velocity and percentage of rated engine power for any altitude and atmospheric temperature as a function of propeller blade angle at .75 R. (Douglas DC-2. Gross weight, 18,000 lb. Two Wright Cyclone SGR-1820-F3 engines. Constant speed propellers, 1,850 r.p.m. diameter, 11.0 ft.)

constant-speed control is in proper working condition).

More supercharging

The development of supercharged engines has been progressing more or less equally in regard to increases in rated horsepower and critical altitude. Power must ultimately increase as superchanging increases because the minimum power required for flight increases with altitude. However, the supercharging capacity of present engines is considerably below that which is warranted by the permissible cruising power. The best interests of transport and military operation would be served in raising the altitude for full throttle at cruising power to nearly the height which gives the highest speed with that power. For modern airplanes, this "optimum" altitude is about 30,000 ft. higher than now available. When supercharging capacity once has "caught up" with engine power, it would be most desirable if increases in engine power and supercharging capacity would then coordinate to meet approximately this desired cruising condition.

Power per passenger constant

The increase in performance of modern airplanes can be attributed to aerodynamic design, controllable-pitch propellers, and a moderate degree of supercharging. Horsepower per passenger has not increased. Further increase in performance is possible in an economical manner through increased supercharging which will permit flight at higher altitudes. Increasing power is unnecessary, and is generally uneconomical. Aerodynamic design of airplanes and the constant-speed propellers have established both the need for and the capability of using (very) high-altitude engines.

On to the stratosphere

The level-flight cruising chart given in Fig. 55 has been extended well up into the stratosphere to 60,000 ft., altitude. The effect of cruising at increasing altitude is clearly shown in Fig. 60, in which there has been plotted the velocity variation with altitude for various values of engine power and engine revolutions for constant-pitch setting. The r.p.m. curves are given values that would be obtained with the present cruising-pitch propeller setting. The actual values at the higher altitudes would be reduced, of course, by the choice of a larger propeller and higher pitch setting. For a constant-speed propeller the constant r.p.m. lines on Fig. 60 would correspond approximately to constant blade angle lines.

By flying at higher altitudes there is a large possible gain in cruising velocity at constant power for the higher powers, but little or no gain for lower powers. The altitude for greatest speed at the maximum speed-power ratio of the airplane increases with power along the line so indicated in Fig. 60. A loss in speed results if the airplane is cruised above this altitude. The cruising speed at 75 per cent power (1,067 b.hp.) increases from 179 m.p.h. at sea level to 201 m.p.h. at 14,000 ft. (the present full-throttle cruising altitude). The speed at this power then increases to 235 m.p.h. at 30,000 ft., and finally to 264 m.p.h. at the optimum altitude of 46,000 ft., above which the speed decreases. At the present full-throttle cruising altitude of 14,000 ft., approximately 1,510 hp. would be required to develop 235 m.p.h. cruising speed, and 2,060 hp. would be required to cruise at 264 m.p.h. This highest possible cruising speed (264 m.p.h.) can be obtained with the present cruising power by supercharging alone, but would require nearly twice the power if obtained at 14,000 ft. The trend of performance of present airplanes with increased supercharging capacity is fairly accurately obtained by a study of this figure. The need for additional supercharging capacity is quite clear.

Cruising at the higher altitudes can be controlled through cruising charts with r.p.m., or propeller pitch setting, as the guide, in the same manner as done at lower altitudes. The added need for constant-speed propellers is brought out by the wide variation of conditions which the propeller must handle. It is also desirable that means be provided in the engine for reducing manifold pressure for operation at lower altitudes.

Altitude vs. net speed

The climb and descent will cause reduction in net speed as altitude increases, so that the trip velocity and altitude for best trip velocity will be increasingly lower than shown for level cruising flight as the trip length decreases. Higher altitude flights are practical only for long trips. The overall trip velocities can be determined in the same manner as previously outlined in earlier articles. The effect of decrease in weight is quite appreciable at the higher altitudes, hence the performance shown in Fig. 60 for the design gross weight will improve considerably as fuel is consumed.

We are now on the threshhold of an interesting and fruitful field in cruising operation and control, and have assurance that operation at desired conditions will ultimately be rewarded in a definite manner by the resulting trip cruising performance achieved. It is believed that, with knowledge of the principles of cruising operation and control for present airplanes and with an understanding of the influences of weight changes, constant-speed propellers, and highly-supercharged engines, the pilot and operating personnel should be well equipped to handle efficiently all problems of cruising operation.

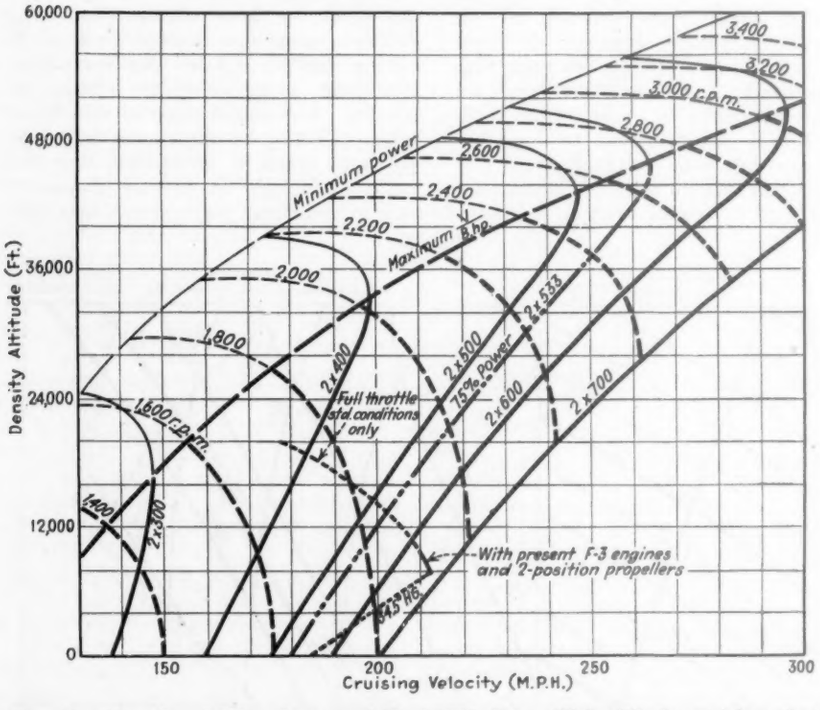


Fig. 60: (Douglas DC-2. Gross weight, 18,000 lb.). High-altitude cruising chart showing the variation of velocity with altitude for various constant values of engine power and engine revolutions. The "optimum" altitudes for maximum speed-power ratio, and altitudes with minimum power are shown. Constant r.p.m. lines shown for cruising control assume same propeller diameter and setting as on the DC2. These are adjusted as desired for any particular case. For constant-speed propellers, constant blade angle lines fall approximately along the constant r.p.m. lines here shown.

EDITORIALS

AVIATION

Foundations of Policy

THE REPORT of the Federal Aviation Commission is out at last. For more than six months the aeronautical world has been waiting for it with varying degrees of anxiety. Its terms have been the subject of the most astonishing amount of rumor, some of which was innocent guesswork, some composed of perfectly honest attempts to forecast the Commission's report from observing the nature of the testimony taken and the demeanor of the members in receiving it, and some apparently purely malignant and rooted in a desire to create dissension within the Commission's ranks and to make any useful outcome of its labors impossible. The exact motive for the fabrication of this last type of story we have never quite been able to fathom. Perhaps it doesn't matter now. Apparently the Commission went ahead and did its job to the best of its ability without permitting itself to be seriously disturbed by any of the tales that were being told about it.

It will take more time than has yet been available to fathom the full significance of this report and to appraise it with complete fairness. One or two things are evident immediately. It is quite plain that the Commission has taken the broad terms of its authorization very seriously and has made a very earnest attempt to acquaint itself with all phases of the aeronautical problem. It is plain too that the work was undertaken, neither in the spirit of propaganda or promotion of any particular fad, nor in that either of justification or of denunciation of past practices. The Commission declined to seek out controversy for its own sake. It proceeded with an eye to the future alone and with an honest desire to find the ways in which and the terms on which aviation can best promote the public welfare. We who believe in aviation and have proven it through long association could ask for nothing better than that. Except where aircraft render a real and vital public service they cannot survive. We believe that they have such a service to render in many employments, and we believe that the Commission has sought them out and analyzed them with considerable skill.

It is too much to expect that so exhaustive a study and so vast a body of conclusion and recommendation will command universal support, and we have no idea that the commissioners themselves were so sanguine as to expect it. A host of factions will rise up to object to particular recommendations or to selected phrases in the discussion. In more general terms, the report will be attacked by conservatives, and by those who for definite reasons of personal interest are opposed to the spread of aviation, as having made recommendations that are too generous. It will be attacked by the more extreme and optimistic of aeronautical enthusiasts as far too conservative. We do not believe that either set of criticisms is justifiable. Those who walk in the middle of the road are liable to be the targets of half-bricks plucked indiscriminately from either sidewalk, but the middle of the road is nevertheless likely to be the best and sanest one.

We have no idea that this report is a perfect document. We find some things in it that are at first sight disappointing, and some omissions that are surprising. Taking it as a whole, however, it seems to us as good a piece of work as could have been hoped for. If it can be accepted as a whole as government policy the results are likely to be far better for aviation and for the people interested in it, and for all the users of its services and for the American people as a whole, than under any other coherent scheme of policy that is at all likely to be produced as an alternative. The report speaks for itself and we have no desire to plead its cause, but we would suggest that those who may encounter either disappointment or surprise as they read it should hold their criticisms in abeyance until they have studied the document as a whole.

Taken by itself, it will stand as a first-class reference work on the state of American aviation and the nature of its problems and of the problems of the government's relationship to it at the end of 1934. But it was not simply to produce a work of reference, but to develop an air policy, that the Commission was appointed. The report will become a policy only when Congress has enacted the appropriate legislation and when the executive departments have made the changes in their own practices that the Commission recommends.

At this point the task ceases to be one for the Commission alone, and becomes the concern of every member of the interested public. The recommendations have been made. Public interest will be a powerful

factor in getting them accepted. Whether or not they are all that any of us individually might have desired, they are the best that is now available as a practical possibility, or at all likely to be. The effort of everyone possessed of the slightest interest in the subject, and anxious that American aviation should be allowed a normal development, should be focussed on presenting to the members of Congress the arguments in favor of an early provision of the necessary legislation.

Liberating the Airplane

THERE IS a natural reluctance to the free use of the potentialities of each new medium of transportation. It required generations for the early maritime adventurers to separate themselves from the shore. It has taken nearly a generation of airplane pilots to liberate the airplane from the ground.

The axiom that there is safety in altitude is one of the first the pilot learns and it is undoubtedly one of the most difficult to practice. It has also been difficult to convince the operators of the economy of operation at higher altitudes. In fair weather 5000 ft. has been the absolute maximum on one line and another could not be induced over 6000 ft. even with the promise of tail winds. And when the ceiling begins to fall, there is a powerful urge to get down where, by dodging chimneys and transmission lines, it is possible to keep an eye on the ground. No matter how far instrument and radio development has progressed. it has been the most difficult of all problems for the pilot to go up and over. And the tragic consequences are well known.

Piloting has been far removed from anything approaching an exact science. It has been necessary to depend too heavily on the judgment of the individual and the man at the controls has been beset by so many variable factors that it is truly remarkable that there have not been many more mistakes in procedure. The job has been something like a highly magnified version of the process of high speed tuning of a three-dial radio with two hands.

In the past few months both piloting and operating methods have been passing through a revolution. One of the most important contributing factors to this new concept is the development of a systematic operating technique, complex in derivation but relatively simple in application and based on a sound technical foundation. The basis of the plan is set forth in the series of articles on cruising control of which the eleventh installment appears elsewhere in this issue. By its use it is possible to study the characteristics of each section of an airline and prepare a reasonably simple chart to guide the pilot in his decisions as to the most economical combinations of the factors determining cruising conditions. Recommendations for most efficient climb and most comfortable descent and correction for the effect of winds are taken into consideration.

Flying by chart and instrument is rapidly replacing the old method of unreliable intuition. The automatic propellers and mixture control devices appearing on the horizon are making an important contribution.

This new phase of air transportation is just beginning. It is a substantial undertaking and, in its early stages, has resulted in some confusion of thought. There is still some need of simplification and clarification. There is also a need for new instruments to relieve the pilot of certain of his burdens.

But whatever difficulties may arise in its application, its development is amply justified for, along with the new independence of the ground, there is an opportunity to reduce operating costs that cannot be disregarded in these days when the future of air transportation depends directly on its ability to conduct operations at lower costs. Every operator and every airline pilot should explore the possibilities of the new technique to the fullest possible extent and cooperate in every reasonable way in its future development.

Winter Housecleaning

ALTHOUGH half a decade has passed since the dreams of automotive mass production for the airplane industry gave place to the nightmare of overproduction and distributor dumping, the chaos of this period has made a most profound impression on the minds of those remaining in the aircraft building business. This memory has been so unpleasant that it has led to a continuance of the hand-to-mouth manufacturing methods of the built-to-order era, even after the production tide had definitely turned. The nibbling machine is still the prevalent production tool in many plants, and airplane parts are fashioned frequently with an unduly high degree of hand work.

The future manufacturing prospects are reasonably bright. Plane makers have had a fairly good season in 1934 and some are looking forward to a better one in 1935. School operators are reporting increased public interest and larger enrollments. There is much more to be gained than lost by the industry in the formulation of a definite long term policy on aviation by the Federal Government. And improving business is not going to wait for any manufacturer whose house is not in order to receive it.

The time seems to be at hand for a winter housecleaning—a thorough examination by each plane producer of his manufacturing facilities, particularly in terms of those of his immediate competitors. There are many reasons to believe that credit will be more plentiful in the near future than it has been for a long time in the past. An investment in a few new machines now to replace obsolete, non-productive, or worn-out equipment and a general renovation of the premises to smooth out kinks in the production line will pay untold dividends when the time comes to bid close on a good-sized future order.

NEWS *of the* MONTH

★ ***Air Mail and Transport*** **. . . Bureau of Air Mail of Interstate Commerce Commission submits report urging revision of present rates of payment to domestic air mail contractors . . . Post Office Department Committee investigating foreign air mail contracts recommends allotment of foreign air mail contracts on two- or three-year basis . . . Post Office Department approves transfer of three domestic air mail contracts . . . Transport companies inaugurate new schedules with new equipment . . . American Airlines opens new transcontinental route . . . Major James H. Doolittle sets transcontinental speed record in Vultee transport.**

★ ***Services*** **. . . Budget estimates for fiscal year 1936 provide for greatly increased plane strength for Army and Navy . . . War Department gives final approval for test organization of GHQ Air Force . . . Newly-created Director of Procurement appoints committee to develop uniform policy for all aircraft buying . . . Navy orders 84 scout bombers from Chance Vought . . . Commdr. J. F. Stone of U. S. Coast Guard sets new amphibian speed record.**

★ ***Financial*** **. . . North American Aviation, Inc. and Aviation Corporation completely reorganized.**

★ ***Flights*** **. . . Amelia Earhart Putnam flies solo from Honolulu to Oakland, Cal.**

★ ***Foreign*** **. . . Raymond Delmotte sets new world speed record for France in Caudron-Renault.**

★ ***Races*** **. . . All-American Air Races held at Miami.**

Air mail rate revision

THE Bureau of Air Mail of the Interstate Commerce Commission has submitted its report to the whole Commission, recommending a general revision of the rates now paid to domestic air mail contractors. The Bureau of Air Mail was created by the Commission last July in accordance with the Air Mail Act of 1934 which directed the ICC to determine fair rates of compensation for the transportation of air mail.

The companies now holding mail contracts had submitted to the Bureau tables of operating costs and income covering the period from early May, 1934 (when the new contracts went into effect), to Oct. 31, 1934. They showed an aggregate net deficit of $1,815,055. Total gross income for the period was $8,902,845.

The Bureau foresaw an imperilled future for the industry if the contractors were forced to continue operating at substantial losses. The report said that if rates were fixed by the use of cost allocations at this time, charging operating costs against each class of traffic in direct proportion to the weight contributed by each to a plane's total load, all incentive for the maintenance and future development of passenger traffic might be destroyed and a tendency to revert to exclusive mail service without passenger and express facilities might follow.

The Bureau accordingly recommended new rates based on the present rate of income or loss of the operators but apparently excluding from consideration entirely any cost of operating extra passenger schedules not covered by the mail contract. The method of computation led to increased base rates on 19 routes (of which 11 are operated by independents), decreased rates on 11 routes (of which nine are operated by the major systems), and no change on one (TWA, Inc., operator). The proposed rates were put on a sliding scale, providing for a drop of 1 cent per mile for every 10 per cent increase in the amount of flying being done with mail. The Bureau recommendations amount almost to a flat-rate basis, with but little regard for the amount of mail or other load carried or the type of airplane used. Whereas the rates at which the new contracts were originally let by competitive bidding ranged from 8 to 39.5 cents, the Bureau of Air Mail recommends an extreme spread of only from 24 to 33 cents.

A comparison follows of the rates which were recommended by the Bureau and the rates now in effect:

Contractor	Route No.	Proposed Base Rate (cents)	Existing Contract Rate (cents)
United Air Lines, Inc.....	1	31	38
T. W. A., Inc.....	2	24	24
Northwest Air Lines, Inc...	3	25	33.75
American Air Lines, Inc....	4	26	39.5
Eastern Air Lines, Inc.....	5	28	19
Eastern Air Lines, Inc.....	6	26	29
American Air Lines, Inc....	7	33	39.5
Pac. Seaboard Air Lines....	8	29	17.5
Braniff Airways, Inc.....	9	28	22.5
Eastern Air Lines, Inc.....	10	29	19
United Air Lines, Inc.....	11	27	39.5
United Air Lines, Inc.....	12	33	39.5
General Air Lines, Inc.....	13	33	24
Central Air Lines, Inc.....	14	33	23.8
Long and Harmon, Inc.....	15	27	19.75
Hanford's Tri-St. Air Lines.	16	25	19.6
Wyoming Air Serv., Inc....	17	29	35
American Air Lines, Inc....	18	31	33⅓
Alfred Frank.....	19	33	39
Robertson Airp. Ser. Co....	20	31	16.7
American Air Lines, Inc....	21	32	24.5
American Air Lines, Inc....	22	28	14⅔
American Air Lines, Inc....	23	26	13
Delta Air Corporation.....	24	28	24.8
American Air Lines, Inc....	25	33	29
Hanford's Tr.-St. Air Lines.	26	32	18.9
National Airways, Inc.....	27	33	29.5
Wyoming Air Service.....	28	29	28.5
Varney Speed Lines, Inc....	29	29	24
American Air Lines, Inc....	30	28	8
Pa. Air Lns. & Transp. Co.	32	33	38.9

The Post Office Department committee, instructed by President Roosevelt last July to investigate the rates paid to foreign air mail contractors, has also submitted its report. Though as yet the report has not been made public, word from official quarters indicated that it contained proposals to change contracts from a ten-year to a two- or three-year basis. Pan American Airways' present contracts have some four years yet to run before expiration. The creation of a new transportation committee to determine when the present rates should be changed was also advocated.

The total cost of the Army mail-carrying operations from February to May last year was $3,767,355, according to a report submitted Jan. 26 by Postmaster General Farley to the House and Senate Post Office Committees. Wrecks and damages to planes amounted to $517,559. In a total of 69 accidents, twelve lives were lost and five pilots injured. Of the total cost, $2,249,004 was paid by the Post Office Department while the War Department absorbed the remainder.

Transport developments

Delivery of a new Lockheed Electra transport to Pacific Alaska Airways, Pan American's northernmost sub-

sidiary, will enable that company to maintain considerably faster service on its two major routes. The Electra will fly between Fairbanks and Nome on the west coast, and from Fairbanks to Bethel on the southwest. Each route is about 550 miles long and will be covered in approximately three hours by the new ship which has been specially equipped for operation at low temperatures with nose shutters over the front of the engine cowling and ice shields over the sides of the fuselage nose. Normally a ten-passenger transport, mail and baggage racks supplant five seats on one side of the cabin.

Following the sale by United Air Lines of several Boeing transports to General Air Lines for operation on the Salt Lake City-Los Angeles route, the mid-continent route now provides uniform Boeing service from Eastern cities to every major Pacific Coast point.

The purchase by National Parks Airways of two Boeing 247 transports from United has resulted in a time reduction from five to slightly more than three hours over the 500-mile route between Great Falls and Salt Lake City.

Pacific Seaboard Air Lines has bought five Stinson tri-motored transports from American Airlines and will place them in service on the new overnight schedule between Chicago and New Orleans, recently authorized by the Post Office Department. (AVIATION, January, page 24.)

A daily non-stop service between Chicago and New York in 4 hours, 5 minutes was inaugurated Jan. 8 by Transcontinental & Western Air, Inc. Heavy traffic over this route warranted the addition of the special west-to-east schedule to the three regular daily round-trips, which with stops at either Philadelphia or Pittsburgh take 4½ hours for the trip.

An 18 hour schedule from New York to San Francisco, clipping one half-hour from present flying time, was started Jan. 8 by United Air Lines. Eastbound service to Chicago was cut 20 minutes to 15 hours. The faster schedules were made possible by Boeing 247-D's. United now flies three transcontinental trips daily, two of which are so arranged that the scenic portions of the route will be flown during hours of daylight. Passengers leaving New York after dinner and Chicago at midnight have breakfast at Cheyenne and lunch while flying over the Sierras, reaching San Francisco in the early afternoon.

New day and night 8-hour schedules between New York and Miami became effective on Eastern Air Lines Jan. 5. Douglas transports leave Newark daily at 9:40 a.m. and 9:40 p.m., while the Miami planes depart at 10 a.m. and 8:30 p.m. All flights are made on a limited stop basis. Eastern Air is also planning to run a Douglas schedule from New York to New Orleans on a nine hour basis, in addition to one Condor schedule.

Arrangements have been completed between Eastern Air Lines and the Sport Fishing Company to offer combination costs to fishing enthusiasts for week-end excursions by plane from Chicago and New York to favorite fishing grounds at Miami and New Orleans. All transportation, food, lodging, and fishing expenses are included in the price of the trip.

Opening a new southwestern transcontinental route, in accordance with recent authorizations from the Post Office Department (AVIATION, January, page 24), American Airlines is now running a Douglas service from New York to Los Angeles via Washington, Nashville, and Fort Worth. The plane leaving Newark at 12:30 noon arrives at Fort Worth at 9:20 p.m. There passengers transfer to a Curtiss Condor sleeper leaving at 10 p.m. and arriving at Los Angeles the next morning at 6:45 a.m.

Calendar

Feb. 20—Meeting of Board of Governors, National Aeronautic Association, Washington, D. C.

March—General meetings, ISTUS, Berlin, Germany.

May 19—Deutsch de la Meurthe Cup Race, Paris, France.

4 minutes faster

In an attempt to set a new transcontinental record for transport planes carrying passengers, Major James G. Doolittle took off from Burbank, Cal., at 8:27 p.m. [E.S.T.], Jan. 14, accompanied by Mrs. Doolittle and one other passenger. When he set his Cyclone-powered Vultee monoplane down at Floyd Bennett Field next morning at 8:26 a.m. he had succeeded by 4 minutes in bettering the record of 12 hours, 3 minutes established by an Eastern Air Lines' Douglas last November (AVIATION, December, p. 402). Loaded with 600 gal. of gas, the Vultee had made the 2,620-mile trip non-stop. Highly unfavorable weather conditions had forced Major Doolittle to fly blind for the entire distance, he had been without radio communication for 7 hours, and severe cross winds east of the Mississippi had blown him as far south of his course as Richmond, Va. Nevertheless his average speed was 218 m.p.h.

Aircraft in 1936 budget

President Roosevelt's budget estimates for the fiscal year 1936, presented to Congress Jan. 7, carry a total of $870,922,292 for national defense in all its phases, one of the largest peacetime national defense budget estimates in history. Of the gross appropriation of $489,871,347 asked for the Navy Department, $22,500,000 would be spent for new aircraft for replacements. Although this represents an increase of $16,369,000 over the appropriations for 1935, $8,500,000 will be required to pay for airplanes purchased this year under the "authorizations" permitted in the 1935 budget. In that connection the President suggested the elimination of future "authorizations" and requested that funds for the particular year in question be appropriated at one time. An additional $12,500,000 was provided for equipping the two airplane carriers now under construction with adequate plane strength.

CALIFORNIA WELCOMES

Amelia Earhart Putnam at Oakland Municipal Airport as she finishes her trans-Pacific hop from the Hawaiian Islands. In a Wasp-powered Lockheed Vega, she accomplished in 18 hours, 17 minutes the first westward crossing ever made over the route.

FASTEST AMPHIBION

A new world speed record for amphibions, of 191.796 m.p.h., was set Dec. 21 at Hampton, Va., by a Grumman JF-2 with Wright Cyclone, belonging to the Coast Guard and piloted by Commander E. F. Stone. The former record of 179.76 m.p.h. was made by Maj. Alexander P. de Seversky in a Seversky amphibion with a Wright Whirlwind Oct. 9, 1933.

Major recommendations for the Army (gross appropriation, $312,235,811) included an expenditure of $48,383,400 for the Air Corps. This sum is a net increase over the 1935 appropriation of $20,737,072, but of this, $3,000,000 must go for the payment of obligations incurred for airplanes purchased this year under 1935 budget authorizations. The President recommended that a total of 547 new planes be purchased during the coming year to bring the number on hand on June 30, 1936, to 1,352, practically all of which would be less than two years of age. In the estimates for the Ordnance Department and the Signal Corps a total of approximately $4,800,000 has been provided for equipping all airplanes now on hand and all of the new ones with modern radio apparatus and armament and for the establishment of ground communication stations.

Andrews heads G.H.Q. Force

Final approval of a test organization of the General Headquarters Air Force and appointment of Lt. Col. Frank M. Andrews as its commander was announced by Secretary of War Dern Dec. 26. Receiving orders directly from Chief of Staff MacArthur, Col. Andrews (photo on page 67) will have charge of every plane in the Air Corps except for a few observation and administrative units. His headquarters will be at Langley Field, Va., which will also be the headquarters for one of the three wings of the Force. A second wing will be based at Hamilton Field, Calif., and the third will be based initially at Fort Crockett, Tex., later at Barksdale, La. As yet no officers have been appointed as wing commanders. (For details of the organization of the G.H.Q. Force see AVIATION, November, 1934, page 368.)

War Department testifies

Views of the War Department on the subject of munitions sales were set forth in a statement recently presented to the Nye investigating committee. In dealing with the subject of aircraft the Department declared itself against government manufacture of planes and equipment since the present rapid development of aviation with frequent changes in types and designs would make this impractical. Present procurement plans indicate, the report said, that in case of war military airplanes could be produced rapidly and efficiently by private industry.

Uniform procurement sought

Director of Procurement, Rear Admiral C. J. Peoples, U.S.N., who under legislation enacted by the last Congress is consolidating the bulk of government purchasing, has created an aeronautical committee of six composed of officials of the War, Navy, Commerce and Treasury Departments. The committee has been instructed to make recommendations for changes of procurement methods which can be effected with existing law, and may also propose new legislation. Commdr. R. D. Weyerbacher, U.S.N., chief of the Materiel Branch, Bureau of Aeronautics, is chairman of the committee. Other members are: Lt. Col. H. C. Pratt, U.S.A., Chief of the Air Corps Materiel Division; Lt. Col. Earl McFarland, U.S.A., executive officer of the Office of the Assistant Secretary of War; Lt. Commdr. William Nelson, U.S.N., Bureau of Aeronautics, Commdr. C. C. von Paulsen, U.S.C.G., acting chief of the Aircraft Division, Coast Guard Headquarters; and John H. Geisse, chief of the Development Section, Bureau of Air Commerce.

Navy contract to Vought

A Naval contract for 84 scout bombers was awarded Jan. 5 to the Chance-Vought Corporation of Hartford, Conn. The planes will be equipped with Pratt & Whitney engines and Hamilton Standard propellers and will cost $2,500,000.

North American becomes operator

North American Aviation, Inc., has completed its reorganization, made necessary by the terms of the Air Mail Act of 1934. The Act prohibits any company holding an air mail contract from having an interest in any other company engaged in air transportation or aircraft manufacturing. The Act also makes it unlawful for any company whose principal business is the holding of stock in other corporations to hold stock in an air mail contractor.

Complying with the Act, North American Aviation, Inc., has sold its stock interest in Western Air Express Corporation to a group headed by Alvin P. Adams, formerly president of National Aviation Corporation. Mr. Adams purchased from North American Aviation, Inc., approximately 160,000 shares of stock of Western Air Express Corporation. There are 222,645 shares outstanding. The shares which were acquired by the Adams group do not carry the liquidating dividend of $2.50 a share declared by Western Air Express Corporation in connection with its reorganization, nor the distribution to stockholders of its 47.6 per cent interest in Transcontinental & Western Air, Inc. According to the balance sheet of Western Air Express Corporation as of Oct. 31, 1934, total assets amount to $717,144, and total capital stock and surplus amount to $635,835. These figures were arrived at after giving effect to the distribution to stockholders of $2.50 per share in cash, and after distribution to its stockholders of the stock of Transcontinental & Western Air, Inc., and after sale of certain flying equipment.

Having disposed of its interest in Western Air Express, North American Aviation, Inc., will likewise dispose of its interest in a second air mail contractor by passing on to its stockholders the shares of Transcontinental & Western Air, Inc., received through the liquidation of Transcontinental Air Transport. (See AVIATION, January, page 25.) The liquidating dividend consists of approximately 279,544 shares of the capital stock of the new Transcontinental & Western Air, Inc. The stock will be distributed Feb. 15 to holders of North American Aviation, Inc., of record of Jan. 31 on the basis

of eight-tenths (8/10) of a share of Transcontinental & Western Air, Inc., for each ten shares of North American Aviation, Inc., stock. No fractional shares of Transcontinental & Western Air, Inc., stock will be issued. A stockholder entitled to a fractional share will receive instead cash based on the value of $7 per share of Transcontinental & Western Air, Inc., stock.

During the past year North American Aviation, Inc., disposed of its two manufacturing affiliates. Stock held in the Douglas Aircraft Company was sold at an accounted profit of $1,199,941, and General Aviation Manufacturing Corporation was dissolved.

North American Aviation, Inc., has now become exclusively an operating company, holding one mail contract—that under which Eastern Air Lines operates. Eastern Air Lines, 100 per cent owned by North American Aviation, Inc., formerly held the contract but was recently dissolved and its contract assigned to North American Aviation.

Aviation Corporation to build

Also reorganizing in accordance with the Air Mail Act, Aviation Corporation will distribute to its stockholders all stock of its two transport subsidiaries, American Airlines, Inc., and Canadian Colonial Airways, Inc., as well as the stock it owned in General Aviation Corporation, now dissolved.

Previously, Aviation Corporation had subscribed to an additional $777,750 of the capital stock of American Airlines, Inc., making its total capitalization $2,777,750. In the eventual distribution of American Airlines' stock to the stockholders of Aviation Corporation, holders of the latter stock will therefore receive one share of Amercian Airlines' stock of $10 par value for every ten shares of Aviation Corporation stock.

A new company is being organized for the purpose of acquiring the businesses of Aviation Corporation's manufacturing affiliates, Stinson Aircraft Corporation; Lycoming Manufacturing Company, Aircraft Engine Division; Airplane Development Corporation; and Smith Engineering Company. Aviation Corporation will supply this new company with $3,000,000 paid in capital, thereby acquiring all of the preferred stock and one-half of the common stock of the new company.

Pacific solo

Successfully accomplishing the first solo flight ever made between Hawaii and California, Amelia Earhart Putnam landed at Oakland Airport in the afternoon of Jan. 12, 18 hours, 17 minutes after taking off from Wheeler Field, Honolulu. She made the 2,400-mile hop in a Lockheed Vega equipped with a supercharged Pratt & Whitney S1D1 Wasp and a variable pitch Hamilton Standard propeller. About 525 gal. of gas and 35 gal. of oil gave the plane a cruising radius of more than 3,000 miles. Since no special preparations had been made for radio beam flying, Miss Earhart navigated by dead-reckoning, supplemented by position-fixes from ship and shore radio stations. Throughout the trip she flew at an average height of 8,000 ft., encountered many rain squalls, cloud banks and fogs, but no severe storms. With speed reduced by head-winds, the plane averaged slightly more than 140 m.p.h.

Mail contracts sub-let

The Post Office Department recently approved several transfers of temporary mail contracts. Northwest Airlines has taken over the Chicago-Fargo-Pembina route from Hanford Airlines; Braniff, the Amarillo-Brownsville route from Long & Harmon; Wedell-Williams Air Service, the Houston-New Orleans route from Robertson Airplane Service Company.

MIAMI RACES

Results of The Seventh Annual All-American Air Races at Miami Jan. 10-12

Event	Place	Pilot	Plane	Engine	Speed (M.p.h.)
200 cu. in.	1	Clarence McArthur	Tillbury Flash	Church J-3	101.258
	2	Waldron J. Schanz	Taylor Cub	Aeromarine	88
375 cu. in.	1	Dwight Cross	Davis	Kinner	188
	2	S. J. Wittman	Wittman Special	Cirrus	186
550 cu. in.	1	Art Davis	Davis Special	Menasco	114
	2	Dwight Cross	Davis	Kinner	107
Green Trophy Race 550 cu. in.	1	Roger Don Rae	Keith Ryder	Menasco	225.465
	2	Art Chester	Chester Special	Menasco	221.416
800 cu. in.	1	Ben Stegall	Travelaire	Wright	150.99
	2	Joseph Musleh	Great Lakes	Cirrus	125.59
Cabin planes from 550-800 cu. in.	1	Alton B. Sherman	Cessna	Cirrus	139.23
	2	Lawrence Schmidlapp	Waco	Jacobs	135.78
Free-for-All (any displacement)	1	Ben Stegall	Travelaire	Wright	165.26
	2	Alton B. Sherman	Cessna	Cirrus	140.52
Venezuelian Trophy	1	Art Chester	Chester Special	Menasco	220.25
	2	Roger Don Rae	Keith Ryder	Menasco	205
Cabin Planes of 550 cu. in.	1	Jack Wright	Monocoupe	Warner	140.65
	2	Harrison Doyle	Monocoupe	Warner	133.97
Sportsman Pilot's Free-for-All	1	Larry Hughes	Waco	Lambert	147.35
	2	Harrison Doyle	Monocoupe	Warner	141.49

New airport classification

A simplified system of airport classification, under which only those airports serving scheduled interstate airlines will be examined for compliance with Bureau of Air Commerce requirements is now effective. Airlines will be authorized to operate only from airports meeting these requirements except in cases of emergency or when a waiver has been granted by the Bureau. Other airports and landing fields will be listed by the Bureau as follows: those having hangar facilities and service for aircraft will be referred to as airports, while those having only landing areas and no hangars or servicing will be called landing fields.

Speed mark to France

A new international speed record for land planes over a closed course was established Dec. 25 at Istres, France, where Raymond Delmotte in a Caudron-Renault monoplane averaged 505.848 km.p.h. (314.32 m.p.h.) in four laps over a three-kilometer course. The former record of 490.80 km.p.h. (304.98 m.p.h.) was made by the late James R. Wedell Sept. 4, 1933, in a Wedell-Williams monoplane with supercharged 800 hp. P.&W. Wasp. Delmotte's Caudron C460 is similar to the type competing in the Coupe Deutsche race last summer, save that its engine has 9½ liters displacement instead of the 8 liters required by the rules of the Coupe Deutsche. It delivers 370 hp.

Reed award

A $10,000 endowment for an annual award in the interest of aeronautical progress has been provided by Dr. Sylvanus A. Reed of New York, well known for his pioneer work in the development of aluminum alloy propellers. The winner of the award will be selected by the Fellows of the Institute of the Aeronautical Sciences and will receive a cash prize of $250 and a certificate of merit.

First to receive the award were Prof. C. G. Rossby and Dr. H. C. Willett of the Massachusetts Institute of Technology, for their work on the practical application of the polar front theory to weather forecasting. The presentation was made at the annual meeting of the Institute of the Aeronautical Sciences Jan. 30. The Institute also elected Dr. Joseph S. Ames, chairman of the NACA, as its fourth Honorary Fellow.

Industry reports

Eight members of the Aviation Division of the Socony-Vacuum Oil Company are making a coast-to-coast tour of the country in three of the company's planes—a new Beechcraft, a Stinson Reliant, and a Bellanca Skyrocket.

From the Sperry Gyroscope Company of Brooklyn, N. Y., comes word that hereafter their automatic pilot will be known as the Sperry Gyropilot.

AVIATION PEOPLE

• Appointment of Lt.-Col. FRANK M. ANDREWS as commander of the G.H.Q. Air Force of Army General Staff, places him in charge of virtually all military aviation. In 1917 Colonel Andrews was detailed to the Aviation Section of the Signal Corps, and during the intervening years has left the air arm only once when he served a term of duty with the American Army of Occupation. Among the appointments which he has held are Post Executive Officer at Kelly Field, Commanding Officer at Selfridge Field, District Supervisor of the Southeastern Air Service, Training and War Plans Division, Office of the Chief of Air Service, and Executive in the Office of the Chief of Air Corps. (See page 65.)

• Reorganization of North American Aviation, Inc. to comply with the 1934 Air Mail Law has resulted in several changes in its executive personnel. J. H. KINDELBERGER, former chief engineer of Douglas Aircraft Company and president of the General Aviation Manufacturing Corporation, succeeds ERNEST R. BREECH as president. Mr. Breech becomes chairman of the board. Capt. E. V. RICKENBACKER remains a vice-president of the company, a position he has held since April, 1934, and has been named general manager of the Eastern Air Lines division. PAUL BRATTAIN is also made a vice-president. In addition to his duties as vice-president of North American Aviation, he will discharge those of assistant general manager of Eastern Air Lines.

• CHARLES FROESCH, formerly project engineer with ANTHONY FOKKER and recently sales and service engineer for General Aviation Manufacturing Corporation, has joined the sales staff of North American Aviation. He will maintain headquarters at New York and Atlanta.

• WILLIAM E. BERCHTOLD, writer, lecturer, and former manager of the air transport section of the Aeronautical Chamber of Commerce, will conduct a new course in commercial air transportation at New York University during the spring semester. This course will supplement those given under Prof. ROLAND H. SPAULDING.

• United Air Lines has appointed HOMER J. MERCHANT its district traffic manager at Los Angeles, to succeed LLOYD O. KENNEDY, on leave of absence due to ill health. Mr. Merchant was formerly associated with Western Air Express, more recently served as United's district traffic manager at Portland, Ore.

Lt.-Col. Frank M. Andrews

Charles Froesch

William E. Berchtold

Fred D. Fagg, Jr.

John H. Wigmore

Richard H. DePew, Jr.

• Appointed legal advisers to the Federal Aviation Commission, Prof. FRED D. FAGG, JR. and Dean JOHN H. WIGMORE are now in Washington. Prof. Fagg is director of the Air Law Institute of Northwestern University, founder and editor of *Journal of Air Law*, member of Illinois Aeronautical Commission since 1931, and served as pilot with the 92d Aero Squadron A.E.F., Dean Wigmore, organizer and dean emeritus of Northwestern University Law School, served on Illinois Commission on Uniform State Laws, Inter-American High Commission, and the League of Nations Committee on Intellectual Cooperation. An extensive author of legal works, he is also holder of the D.S.C.

• The National Industrial Recovery Board has approved the appointment of C. BEDELL MONRO, president of Pennsylvania Airlines & Transport Co., and C. R. SMITH, president of American Airlines, as members of the code authority for the air transport industry to succeed H. S. MARTIN and L. D. SEYMOUR, resigned.

• C. E. FLEMING, formerly mail traffic manager for American Airways, has been named by TWA to serve in like capacity at Kansas City. He succeeds C. W. H. SMITH who is now in the New York office of Eastern Air Lines.

• LEE B. JAMISON, district traffic manager for United Air Lines at Salt Lake City for the past two years, has been transferred to Washington, D. C. S. R. NEWMAN, formerly of San Francisco, takes his place.

• At the annual election of officers by The Early Birds, WILLIAM E. SCRIPPS became president; E. M. LAIRD, first vice-president; R. H. DEPEW, JR., second vice-president; VINCENT ASTOR, third vice-president; AUGUSTUS POST, treasurer; and Maj. ERNEST JONES, secretary.

• E. G. NABELL, formerly with Lockheed Aircraft Corporation, has been appointed factory superintendent of Ryan Aeronautical Company, San Diego, to supervise production of the new Ryan S-T low-wing monoplane.

• HENRY WHITE, aviation sales manager for the Socony Vacuum Corporation, has returned from abroad where he made a wide tour of European airports in the company's Jacobs' powered Beechcraft.

• The following representatives have been designated by their various organi-

zations to serve on the Advisory Committee to the American Section of the International Technical Committee of Aerial Legal Experts: G. B. LOGAN, National Association of State Aviation Officials; R. BARTON, JR., National Conference of Commissioners on Uniform State Laws; J. C. COOPER, JR., American Bar Association; H. KNOTTS, Independent Aviation Operators; R. P. THACH, National Aeronautic Association; A. W. KNAUTH, Maritime Law Association; J. E. WEBB, Aeronautical Chamber of Commerce; B. LEE, American Society of International Law; and R. B. LYNCH, Board of Aviation Underwriters.

• Presidency of the Lambert Aircraft Corporation, formerly known as the Monocoupe Corporation, has been assumed by J. D. WOOSTER LAMBERT, replacing P. R. BEASLEY, one time head of the Detroit Aircraft Corporation.

• Visitors from abroad have been THEA RASCHE, German pilot; Maj. RAMON FRANCO, Spain's premier flyer, who is here to study training and selection of pilots and organization of military and commercial aviation; and ELLY BEINHORN, German aviatrix. Miss Beinhorn has been on extensive flights over Central America and Mexico and will confer with authorities on Mayan archeology.

• Associated with the development of the Bendix Stromberg Carburetor since 1912, FRANK C. MOCK now becomes vice-president in charge of carburetor engineering of Bendix Products Corporation.

• Partner in the newly formed Chandler-Groves Company of Detroit, manufacturers of aircraft carburetors, is M. E. CHANDLER, recently vice-president of Bendix Stromberg Carburetor.

• ROBERT E. GROSS, treasurer and chairman of the board of Lockheed Aircraft Corporation, has been elected its president on resignation of LLOYD STEARMAN, who plans to devote his entire time to aeronautical research. CARL B. SQUIER, vice-president and sales manager, fills the vacancy on the board.

• CHARLES HUGH CHATFIELD, United Aircraft and Transport Company's former assistant director of research, becomes chairman of the technical advisory committee of United Aircraft.

• During the Morro Castle disaster, Ensign MATTHEW G. SELESKI of the Naval Reserve, piloting a land plane, effectively directed rescue boats to the aid of survivors. For his skill and courage Ensign Seleski has received a laudatory letter from Secretary of the Navy Swanson.

• Tyson Roller Bearing Company of Massillon, Ohio, has as vice-president in charge of sales, GEORGE C. MCMULLEN.

FLYING SERVICES *and* SCHOOLS

• The National Code Authority for the Commercial Aviation Industry has voted that an assessment of 50 cents per employee with a minimum fee of $3 be levied against each member of the industry. Ballots have been mailed to all registered members of the industry for the election of members to the permanent National Code Authority and the Regional Code Authorities, and election results will soon be announced.

• A complete survey of the economics of air transportation is now being offered by Northwestern University, Chicago, Ill., in its evening school of commerce. Thomas Wolfe, district manager of United Air Lines, is the instructor of the course. The survey takes up the history, development, and probable future trends of air transportation, the organization and management of airlines, investment problems, traffic control, government regulation, aid air law.

• Manager of Candler Field, Atlanta, Ga., for the past six years, Jack Gray was unanimously elected Jan. 10 to another four-year term by the city's 1935 aviation committee.

• The newly-formed Aero Club of Parks Air College was formally admitted to membership in the National Aeronautic Association at a dinner in St. Louis on National Aviation Day, Dec. 17. Maj. James G. Haizlip awarded the NAA charter and Oliver L. Parks, president of the school, presented each club-member with a certificate of membership.

• Edward W. Schmuck has been appointed instructor in charge of aircraft maintenance and repair at the Ryan School of Aeronautics. His brother, Charles, who has been associated with him in aviation activities for a number of years, has entered the production department of the Ryan Aeronautical Company. Prior to joining the Ryan forces, they were in the production department of Kinner Aircraft Company. Both have had extensive flying experience and were early holders of the transport license.

• New director of a flying school operated by R. A. Rearwin, president of Rearwin Airplane Company at Fairfax Airport, Kansas City, is George M. Prescott, who formerly operated an air service at Kansas City, Mo.

• The University of Minnesota Flying Club, winner of the 1934 award of the Loening Trophy, has recently added 30 new members. Two are women.

• The management and personnel of Amphibions, Inc., which is no longer in active production, have reorganized

NEW TEAM

Art Goebel, winner of the Dole Flight to Hawaii and well-known movie and exhibition flyer poses with the Boeing P-12 which he will use during the coming season.

as the Privateer Aircraft Engineering Company to carry on the general servicing, repair and rebuilding business of the former company. With a flying personnel experienced in all sorts of aircraft they are able to offer a convenient pick-up and delivery service to plane owners. The new organization will be based at Roosevelt Field, Long Island, New York.

• Wesley Yereance, who completed his work in the mechanics flight course at Parks Air College in December, 1933, and has since been associated with Howard Ailor, Waco distributor at Roosevelt Field, New York, has returned to Parks as an instructor. Mr. Yereance holds a degree in Industrial Engineering from Yale University.

• In his annual report to stockholders, Casey Jones, president of the Casey Jones School of Aeronautics, Newark, N. J., announced that the school has now an enrollment of 270 active students and that the balance sheet for the fiscal year ending Jan. 1, showed a profit on operations.

• Through its president, Jack Frye, who is himself an enthusiastic sportsman pilot, Transcontinental & Western Air is encouraging the owners of private airplanes to use the servicing facilities available at all airports from which the company operates. Mr. Frye has issued instructions to TWA field managers, meteorologists, and mechanical staffs to extend to all private fliers every possible service, including free weather information, routing information, servicing and repairs. Fuel supplies may be purchased without any cash outlay upon presentation of a special private fliers' courtesy card issued by the airline, which provides for a billing on the first of the following month.

SIDE SLIPS

By Robert R. Osborn

OUR editorial hat is off to Amelia Earhart for her flying ability as well as for her personality. We have had occasion to remark several times that aviation has been fortunate, in that most of our people who have had the ability to accomplish the outstanding feats which have made them public heroes and heroines, have also had the ability to be unspoiled by public adulation. Many more happy landings for Amelia!

We were disturbed, however, by the news that she was able to keep in con-

stant radio communication with her husband during the flight. It points to the possibility in the near future that wives will not only be outperforming their husbands in aeronautical accomplishments, but will be able to keep close tabs on them at the same time. While taking away from the male his long-established claim for physical superiority, they would still be retaining their long-established privilege of taking up most of his time with the countless small orders—"Please put some coal on the furnace," "Better put out the cat for a while before you go to bed," "The ice box needs de-frosting, dear."

THE 1934 Air Mail Law certainly brought about a lot of high class financial juggling in the closing days of the year. The fun was brought about by the clauses which prevent any company whose principal business was the holding of stock of other corporations, from holding the stock of a corporation having an air mail contract. Although we have read the article over several times the best we can make of it is that General Aviation Corporation, North American Aviation, General Motors, Western Air Express, TWA, Transcontinental and Western Air, Transcontinental Air Transport each held 980,893½ shares of each other's stock, which gave each one 47 per cent control of the other corporation. In the process of the reorganization required by the law, as we understand it, the stockholders will receive $2.50 in cash and 1½ shares of stock in stock of some other corporation than the one they originally owned.

We have always had great admiration for the financial lawyers of this country who are able to toss about the most complicated figures like so many badminton birds, but we'll bet in this case that even they won't know how high they have been financially even after all of the instruments have been calibrated and the data reduced to standard atmosphere. Also, we do think they made a serious error in having any cash involved in the transaction—one can't tell what Mr. Farley will do next if he finds out that the air transport companies still have some money left.

SOMEHOW, all of this reorganization of the air mail companies reminds us of an unusual announcement we once saw on the front of a restaurant in New York City—"on and after March 1st, this restaurant will be under the same management."

WE SEE by the papers that the British are working on a new idea, which they call a "Composite airplane," which they hope will improve the efficiency of long distance flying service over water. They have a smaller seaplane, carrying a heavy gasoline and payload, with very small wings of extremely high loading, mounted on top of a larger seaplane of large wing area, light wing loading and power loading, so that it can easily take off from water with the heavy combination load. When the large seaplane has reached approximately five thousand feet and is making its maximum level flight speed, the small seaplane will then be able to take off from its back and continue on its way. When the small seaplane has arrived at its destination it will have consumed enough of its fuel load that it will be able to make a normal landing as a seaplane.

It is interesting to speculate on the possibilities of this idea and to consider the high wing loadings possible with this arrangement. We are still expecting to see the day when the wings of racing airplanes will be small fins cast on the crankcase, providing the designer thinks he will need area in addition to that of the cooling fins normally provided for the engine.

THIS British "Composite airplane" development reminds us of a designer friend of ours who was working out the possibility of a transport to fly from one coast to another non-stop. Starting with what he thought would

be a reasonable size, after a couple of week's study he finally arrived at the conclusion that when he had sufficient gasoline on board for the non-stop trip his airplane would be able to carry one person—the pilot. Now he is considering establishing a trans-continental high-speed service for highly skilled pilots.

FLYING EQUIPMENT

Seversky Basic Trainer

THOSE laconic releases the Air Corps issues from time to time announcing the allocation of a contract for new flying equipment are never without interest. Occasionally they are as packed with implications important to the industry as a new air mail bill. The recent award of a contract for 35 basic trainers to the Seversky Aircraft Corporation is a case in point. For between the few lines that announced it could be read the Corps' decision to spread its replacement program into training as well as service types, to extend markedly its use of high performance machines in transition training, and to recognize the ability of a comparative newcomer in the industry to provide the high quality of product it insists upon.

To the person unfamiliar with Air Corps methods of designation, the expression "basic trainer" might well call up a picture of a heavy-wired biplane, with rugged landing gear, freight car fittings and a top speed of about 110 m.p.h. Such planes however are known to the Corps as primary trainers. A basic trainer is something more advanced, a transition type to ease the cadet's progress between the primary and the modern combat planes. And in the case of this Seversky design at least the ruggedly slow biplane concept is about as far from accurate as one could possibly imagine. For the SEV-3XAR is a low-winged all metal monoplane, capable of 200 m.p.h. and incorporating a host of modern detail refinements. Substantially it is the Seversky amphibian without its floats.

The fuselage is of circular cross-section, a true monocoupe, with aluminum alloy sheet skin over narrow ring bulkheads and extruded stringers. The fin is built integral with the fuselage, a 2 deg. offset compensating for slipstream effect. The steel tube engine mount forward of the fire wall is suspended on rubber bushings and has been designed for any of three engines, the R-975, R-985, or the R-1340, with simple changes. An unusually deep N.A.C.A. cowling is fitted. Between the two cockpits is a crash-proof head rest, designed to give a minimum of interference with pilot vision. Sliding transparent covers permit open or closed flying at will.

The wing is likewise of stressed skin design. The underpart of the fuselage has been cut away to clear the wing structure and attachment is made through multiple bolted fittings concealed under the fillet. The wing section is based on the Clark Y modified slightly at the nose and with reflexed trailing edge. The chief structural elements are five metal box spars. Longitudinally corrugated alloy sheets are riveted along the top flanges under the skin proper. The under surface is stiffened by the use of transverse inverted U sections.

Major Alexander P. de Seversky, head and designer of the Seversky Aircraft Corporation since its founding in 1931.

Paul Moore, active Seversky director, and with his brother Edward S. Moore industrial sponsor for the company.

The ailerons are of the skewed type, statically balanced and rigged with a differential action. Longitudinal balance is achieved by the use of tabs on the elevators. All controls are equipped with ball bearings. Aerodynamically of major interest is the large trailing edge flap, or discelerator, as the Seversky engineers have termed it. As can be seen in the accompanying half tones it is continuous across the center section and has a substantial downward travel (45 deg. between positions). It is operated by a crank and worm gear combination from the left side of the pilot's seat.

Other interesting design features are the use of a part of the wing structure directly as storage space for fuel, a wide extension of structural multiplicity of great value in direct military combat work in resisting the effects of gun fire, and the installation of a retractable landing-gear operating mechanism complete with warning signals entirely for practice purposes since the landing-gear is actually of the fixed type.

Equipped with a 350-hp. engine the major factors of the plane's performance are as follows:

Top speed at sea level	200 m.p.h.
Stalling speed at sea level	60.5 m.p.h
Climb in 10 min. (sea level)	12,000 ft.
Service ceiling	21,500 ft.
Operating speed	187 m.p.h.
Range at full speed	633 miles
Range at operating speed	742 miles

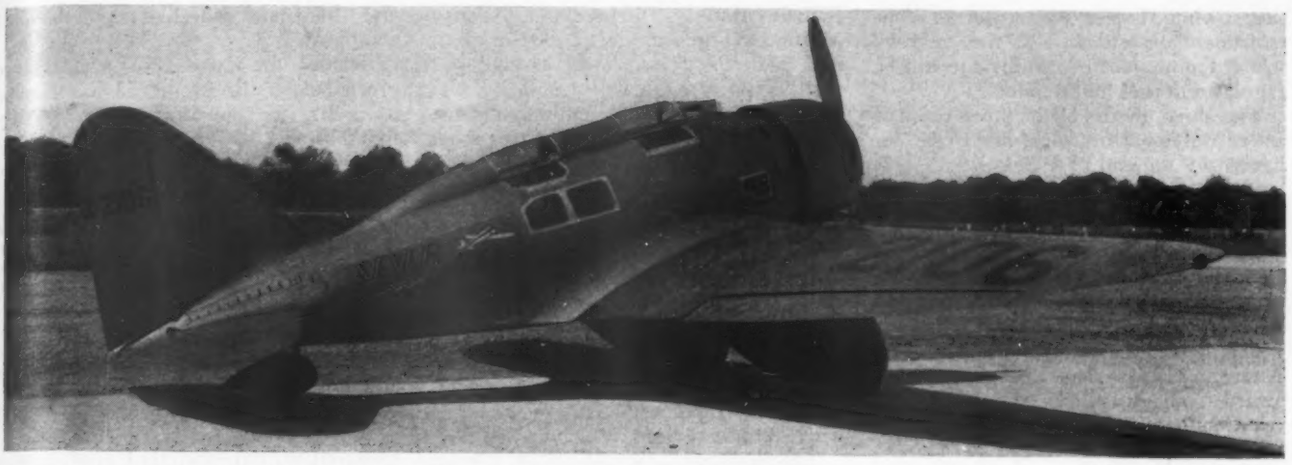
Scout-Bombers

THE DATA available on the 84 planes being built for the Navy by the Chance Vought Corporation is still extremely fragmentary. But since it promises to remain so for some months due to the Navy Bureau policy of preserving secrecy on new developments, we offer here the total of what seems fit and proper for us to divulge.

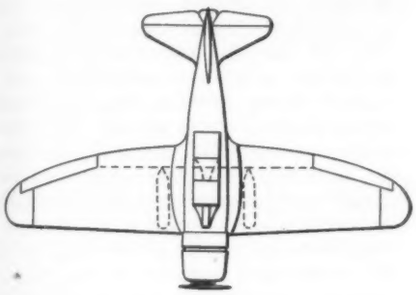
The new planes will be of the scout-bombing class, carry the designation of SBU-1, and be powered with the latest version of the Twin-Wasp Junior developing 700 hp.

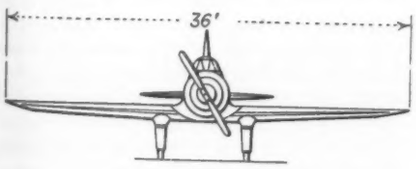
They are biplanes. Their entire structure is of metal and is fabric covered except for the fixed tail surfaces which are covered with alloy sheet. The lower wing is equipped with split flaps to hold the landing speed within the range for carrier operations. And a great deal of attention has been paid to cleaning up the design for aerodynamic efficiency. The crew is completely enclosed, all external bracing has been removed from the tail structure. There are large fillets on wings and tail. There are cuffs on the struts. Even the interaileron struts have been completely concealed.

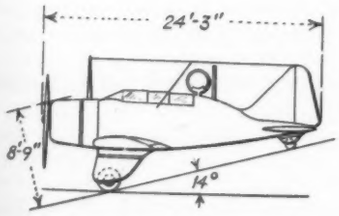
The engine is to be equipped with a Hamilton Standard controllable pitch propeller and a cowling of the new type recently described in the prize winning S.A.E. technical paper by Beisel of Vought & MacClain and Thomas of Pratt & Whitney. A modification of the orthodox N.A.C.A. design, it comprises three features,—(1) pressure baffles attached to the engine and directing the cooling air against the cylinders; (2)

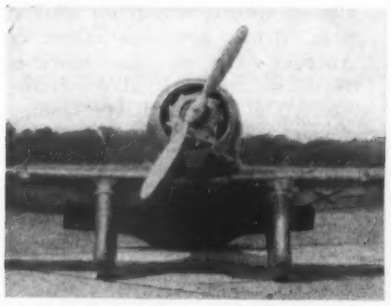


Seversky SEV-3XAR, the Air Corps' new 200 m.p.h. basic trainer. Derived from the World Record Holding Seversky amphibion.

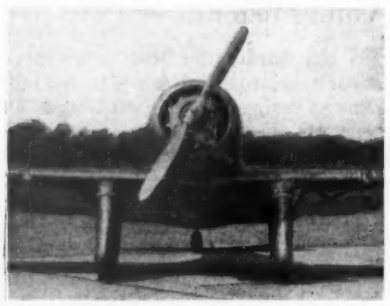






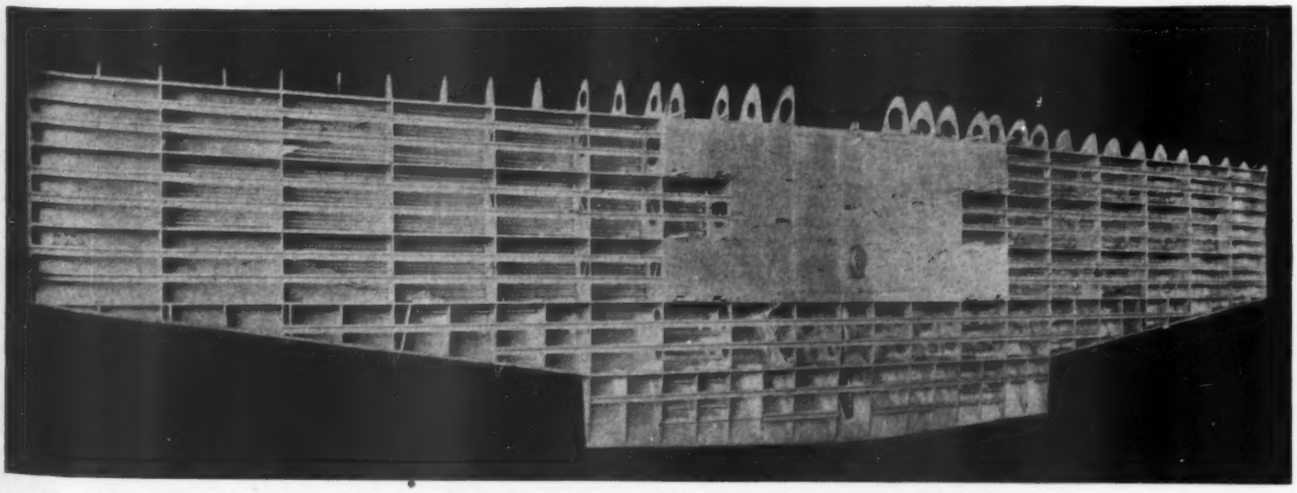


With discelerator down.



With discelerator up.

A view of a Seversky monocoque fuselage in the process of construction.



The wing structure is based on five box spars reinforced along the upper flange by a longitudinally corrugated inner sheet.

the cowling itself; (3) a set of controllable flaps attached to the cowl by which the amount of cooling air can be regulated at will by the pilots.

The ships, the result of three years of active development work, are to be delivered by the end of 1935.

New A.T.C.

THE interesting two-place cabin "flyabout" built by the Porterfield Aircraft Corp., of Kansas City, Mo., which was described in AVIATION for August, 1934, has been recently awarded an A.T.C. by the Bureau of Air Commerce. Powered with the Velie 65 hp. engine it is priced at $1,575; with the LeBlond 70 hp. at $1,675.

Young Veteran

IT IS hardly the custom of this department to print the pictures of airplanes designed six years ago. But

An airplane design can receive no greater tribute than this—six years after its first appearance the Fleet biplane trainer establishes a new high in export sales, 122 plus parts for seventeen going abroad in 1934.

when an American aircraft achieves an export sales record of well over 100 units during a twelve months period it deserves a place in this or any other part of the magazine. Such is the case with the Fleet biplane trainer, still in production by the Consolidated Aircraft Corporation of Buffalo, which has just completed its best export year although its first appearance was made at the Chicago Aviation Show of December, 1928.

Foreign orders for the Fleet taken during the year 1934 totalled 102 complete units, equipment and material for twenty to be manufactured under foreign license, and approximately fifteen equivalent airplanes in spare parts. The corporation enters 1935 with orders for 31 complete planes, plus equipment and material for twenty additional and with prospects for at least equalling the 1934 record export volume.

Twenty-five were equipped with the British-Made DeHavilland Gipsy Major 130-hp. engine, for European use, while 97 were or will be equipped with Kinner engines, principally the B-5 Model of 125 hp., although some of the R-5 160-hp. model are used. One hundred and twenty from the total of 122 are for governmental services.

Stearman 73

FROM Wichita, Kansas, comes word that the Stearman Aircraft Company has the production of 41 primary trainers for the Navy well underway. The trainers, of typical sturdy Stearman design throughout, are to be powered with 220 hp. Wright Whirlwinds.

The fuselage and tail group are of welded steel tube construction, fabric covered. The wings have spars and ribs of spruce, aluminum alloy channel drag struts, are also fabric covered. Ailerons are of the fabric-covered riveted aluminum alloy frame-work type. The full cantilever landing gear and the tail wheel are both oleo equipped.

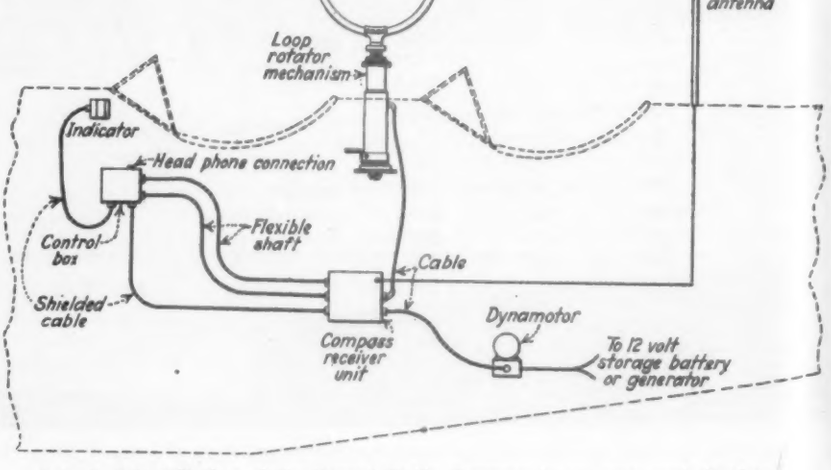
Besides the factors of performance given below, the Model 73 has proven its ability to take off and clear a fifty foot obstacle within 750 ft. in still air with full load and to land over the same within the same distance.

Full speed at sea level	125 m.p.h.
Stalling speed at sea level	51 m.p.h.
Climb to 5,000 ft.	8.8 min.
Service ceiling	14,000 ft.
Endurance at full speed	2 hours
Endurance at 60 per cent V max.	6.5 hours
Range at full speed	250 miles
Service Range (@75 per cent V max.)	430 miles.

Commercial Radio Compass

THE Kruesi Radio Compass for aerial navigation, manufactured by the Fairchild Aerial Camera Corporation, has recently been made available for the use of air transport lines, commercial flying service operators and private fliers. It is of the type that enables the pilot to establish and follow a direct course by means of the signals or the programs broadcast by commercial and private radio stations, as well as by means of the signals of the government stations along federal airways. It provides radio direction in areas where the established airway facilities do not exist and makes the pilot independent of the fixed airways when he desires to fly away from the beam to avoid specially unfavorable conditions, or for any other reason. Besides serving as a homing device, the Kruesi compass may be used as a position finder in the air, or on the ground in the event of a forced landing. It may be used when flying either *to* or *from* a selected station.

Developed at Wright Field, Dayton,



A typical installation of the Kruesi Radio Compass in an open cockpit plane.

The Stearman 73 primary trainer of which 41 are being built for the Navy at Wichita.

Ohio, by Geoffrey G. Kruesi under the direction of Capt. Albert Hegenberger, the army prototype of the commercial model has been tested under a wide range of service conditions, made a key unit of the Air Corps blind landing system and at present is being built in large numbers for service installation.

In the new commercial model tuning and changing of wave bands have been simplified by eliminating a number of operations entirely and by making others automatic.

To establish a course in bad weather the pilot selects a government or commercial station on his course or at his destination, tunes in on the signals or program broadcast by that station by means of earphones, and then switches from the earphones to the bearing indicator. The position of the pointer on the large face dial of the bearing indicator indicates the direction of the plane in relation to the desired course. The pointer at Zero indicates the plane is "on course." If the pointer is to the left of Zero the plane is headed to the right of the course and correction is made by applying left rudder. If the pointer is to the right of Zero the opposite is true of course.

Having maneuvered the pointer to Zero the pilot merely has to hold it there, checking his drift by comparison between the magnetic and radio compass bearings. If the rotatable loop is used, the Kruesi Radio Compass may be employed to establish position with no alteration of the airplane's flight path. The loop is rotated by a hand wheel until Zero bearings have been obtained from each of two selected stations. The rotating mechanism includes a 360-deg. scale readable to one degree. By means of this scale each indicated bearing can be quickly read and lines drawn on a map with reference to the magnetic compass course. The intersection of the lines indicates the airplane's position.

The Kruesi Radio Compass consists of four principal units—the compass receiver, the bearing indicator, the remote control box, and the fixed or rotatable loop. Altogether, with flexible cables and wires, the device weighs approximately 45 lb. A dynamotor and storage battery are required in addition to the above. The filament voltage is supplied from a 12-volt airplane starter storage battery. The plate supply is obtained from a dynamotor operating from the starting battery.

The commercial type receiver is one compact unit which not only saves weight and space over other models but operates entirely by remote control. It has a frequency range of 150 to 1,500 kc., in the following bands: 150-200 kc.; 250-500 kc.; 450-900 kc. and 800-1,500 kc. The compass receiver unit includes heterodyne receiver with five tubes and automatic or manual volume control. The other tubes are included in the direction finder circuit. It occupies only about 1,000 cu.in. of space.

All tuning and switching is concentrated on the remote control box panel, which includes a tuning dial calibrated with the bands used, a pair of switches, a jack for the headphones, and a handle for tuning. This box requires only about 100 cu.in. of space and can be located wherever it is most convenient for the pilot. Bands are changed merely by turning a switch. This automatically makes the necessary changes in the loop and receiver. The needle inclination is steady irrespective of voice modulations up to 100 per cent.

The iron core dynamotor type bearing indicator has a large face to make it easily readible and is designed for installation on the instrument board. The face is finished in black and the pointer and dial scale are painted with luminous radium material. The pointer moves through an arc of 70 deg. It may be used as a turn indicator to a certain degree.

The streamlined loop, with a diameter of 21 in., produces a drag of only 4 lb. at 190 m.p.h. and a drag of 8 lb. at 250 m.p.h. when in position at right angles to the direction of flight. It is easily demountable. The rotatable loop rotates through 360 degrees, is turned by a hand wheel and may be locked in any position. The loop is used in conjunction with a standard mast antenna, projecting 6-8 ft. from the fuselage, or a fixed wire antenna not more than 10 ft. and not less than 9 ft. long.

Satisfactory bearings under average operating conditions may be received at a distance of 300 miles overland and 700 miles over water, at frequencies under 600 kc. Under favorable conditions bearings have been established over a distance of 1,500 miles.

Condor modified for freight or ambulance use.

Freighter

A NEW modification of the Curtiss-Wright Condor, the Model CT-32 basically similar to the Air Corps Type YC-30, has been designed for optional use as a 16-place troop transport, as a 6-litter ambulance, as a cafeteria, or as a freight carrier. Note, in the photo at the left, the monorail hoist and the large door opening made possible by folding back a panel in the turtle deck.

OPERATOR'S CORNER

An exchange of ideas on the problems of the commercial aviation industry

QUESTION 2: What method of charging for flying time in student instruction have you found to sell best to the student? Is your charge based only on time in the air or have found it preferable to lower rates and make an additional charge for taxi time? (Answers in addition to those which follow will be published in March.)

Lieut. John C. Carroll

Joshua Crane, Jr.

D. E. Richardson

L. G. Mason

E. L. Markham

J. B. Plosser

Two classes of students

OUR flying students are grouped in two classes. Those who are regularly employed at our school, and attend ground school classes along with the flying courses, and those who purchase flying time at various and sundry times, and in amounts varying from 30 minutes to 20 hours. In the latter class we also include those pilots who are desirous of purchasing sufficient flying time for renewal of license, and also those persons who enroll for "refresher courses." In the first group we have made an hourly rate which includes ground school and flying, and charge each student regularly enrolled on that basis. For example, our limited commercial course includes 40 hours of flying instruction, in addition to a complete four months ground school course. The price of the limited commercial course is $520 and by dividing this amount by the number of hours of flying time included, we arrive at a very definite rate to which all students enrolled in the above course are charged. It simplifies bookkeeping considerably, and assures the student of receiving ground instruction at the same time he receives flight instruction. For all students coming under group two, as described above, we have a rate per hour, depending upon the type of plane that the student wishes to fly.

All charges made for flying time are based upon the time the school plane leaves the line, and the time it returns to the same place.

Taxi time at the Spartan School of Aeronautics would be included at the same rate as actual flying time. In no case, however, would a student consume more time than one or two minutes in taxiing on the field. As a matter of fact two minutes would be a maximum. The minimum depends upon the direction of the wind, which would make it necessary for a student to land, turn around, and taxi back, or whether he would land and taxi up to the line.—LIEUT. JOHN C. CARROLL, *chief flight instructor, Spartan School of Aeronautics, Tulsa, Okla.*

One flat hourly rate

WE have found that an hourly rate based on operating costs, depreciation, overhead, hangar rentals, etc., charged the same to all classes of pilots has proved satisfactory for our operations. For flights less than an hour, we charge for the proportionate fraction of the hour. We charge from the time the plane starts taxiing out to the field until it gets back to the line again. If any undue delay was experienced in taxiing, either in taking off or in landing, that time is deducted. Our rates are as follows: Kinner K5 Sportster, solo, $10.80.—dual $15; Fleet K5, solo $9.90—dual $14.10; Aeronca C3, solo $6—dual $10.20.—A. ELLIOTT MERRILL, *president, Washington Aircraft & Transport Corp., Seattle, Wash.*

Taxiing a part of instruction

WE have a reasonably low rate for solo flying time. The student pays the regular solo rate as soon as he takes over the controls and continues until the ship is taxied back to the starting line. We believe this to be the best method inasmuch as the student is actually learning an important phase of flying when he is handling the ship on the ground.—D. E. RICHARDSON, *Ann Arbor Air Service, Ann Arbor, Michigan.*

Eliminate charges for incidentals

IN most cases we find the student better pleased with a flat quotation of so much for a certain number of hours of time in the air, than with a lower price plus a number of unknown incidentals. We believe it advisable to include taxi time in our charges for instruction rather than to make an additional charge, because it not only eliminates additional bookkeeping, but what is more important, it does not encourage the student to add to the wear and tear on the ship by taxiing at a high rate of speed over rough portions of the airport or to take unnecessary chances in taxiing thereby saving himself a few dollars on the cost of his instruction.—CRAIG ISBELL, *Springfield Aviation Co., Springfield, Ill.*

Separate charges cause disputes

WE have found it more satisfactory to make a straight charge of so much per hour for the ship from the time of its departure from the line until its return. This eliminates all disputes and "red tape" that might be entailed in segregating the air time from the taxi time. We have never received any criticism on this method after eight years of student instruction work.—LEE U. EYERLY, *president, Eyerly Aircraft Corp., Salem, Ore.*

Strictly cash

WE have found it most practical to charge for flying time, cash for each lesson. We have one rate for dual instruction and a lower rate for solo time. We use a time recorder chart and charge the student with the time when he leaves the apron until the time he returns to the apron. In case of cross country flights we of course make special arrangement for stopover time, based on the individual trip. —L. G. MASON, *Montgomery School of Aeronautics, Montgomery, Ala.*

Time recorder essential

OUR method of charging for flying time is to charge for all of the time the plane is used by the student between the first takeoff and the last landing. We do

not charge for taxiing time from the line to the point of original takeoff or for the time from the last landing back to the hangar, but do charge for the time on the ground while the instructor is explaining to the student and while the student is taxiing between the landings if flying solo. We have a time recording instrument in our training ship which shows very accurately the time that the student has the airplane, so there can be no question about this item. We have found that the recorder meets with the approval of the students as well as ourselves. We have always charged by the hour for instruction. We have never attempted to sell a course of training, as the length of time required to bring a student to the point of solo is different in almost every case.—M. E. Oliphant, *secretary, Michigan Aeronautical Corp., Ypsilanti, Mich.*

Half hour minimum

We have had the best results with nothing less than a half hour or more of flying at a time. Our time is computed from the time the plane taxies away from the blocks until it returns. We require our students to turn planes around after every landing, because we maintain the student needs training in handling his ship on the ground as well as in the air. Being able to taxi where he wishes, he always shows marked improvement in takeoffs and landings. Ground loops are prevented as he feels what the plane is going to do just before it gets too much headway in the wrong direction. All time in the ship is instruction time and should be pointed out to students as such. When they are landing and taking off and working to bring their judgment and skill to a better stage of perfection, the time should be paid for accordingly.—E. L. Markham, *secretary and treasurer, Meriden Aircraft Corp., South Meriden, Conn.*

Payments spread over course

Our school has found it best to charge a flat rate on the entire course, payments to be made on a down payment at the time of entrance and the balance divided over the period of time the student will be taking the course. Our rates have been lowered and our charges are made on air time and taxi time.—J. B. Plosser, *president, Grand Central Flying School, Glendale, Calif.*

Aeronca taxi cost low

At the present time we have a flat charge for a solo course, which gives the student all necessary dual and one short solo flight. We also give flying time by the hour, and if a student chooses this method of paying, it costs him about 20 per cent more than if he accepted the flat rate for the course. This latter method is often used by students who have already had some instruction, and also by students who believe they are better than the average and expect to solo in a very short time. The charge for flying time is based on time in the air and no charge is made for taxi time. Our reason for this is that we use Aeroncas almost exclusively for this work, and we figure that taxi time costs us practically nothing. Also, we seldom have such a rush of business that time is an element to be figured.—Malcolm L. Hathaway, *Tred Avon Flying Service, Inc., Easton, Md.*

Sliding rate scale

I have found that a contract sliding scale schedule seems to have worked out best. Time recorders with waxed recording charts (such as 3-hour-per-revolution Ohmer-Fare Vibracorder) in the planes are essential. This eliminates arguments. A file of cards, which the students may examine at any time, and which show the credits of their payments on one side and a record of their debits for time on the other, also helps. This is valuable also to the operator, as he can then take small payments as the students fly, and have a record immediately available showing whether each student must pay some more before he flies, or how much he can fly on his balance. In this way no student "gets too far ahead" of the operator—and then never comes round again, which has often happened.

I inaugurated the contract system after carefully analyzing operation costs. The gas and oil costs were low as compared to standing overhead charges and obsolescence (rather than depreciation) charges. So also were the ship and engine maintenance charges. Therefore it is apparent that the more hours per year the ship can fly (thereby reducing these fixed charges per hour) the less per hour it costs the operator, and the cheaper he can let the ship out and still make money. By passing the reduced charges along to the student, we found he flew more hours, that there were more hours put in on the ship, thereby reducing the cost per hour, and both operator and student were better off in the long run.

We sell a contract for $9 or $12 depending on whether it is for solo or instruction. While in the possession of the student and valid, this entitles him to a 33⅓ per cent discount from the regular rates. As our solo rates were $9 per hour, and our instruction rates $12 per hour, we chose these figures for our contract price. The contract remains valid for one month from date of purchase or, if a student wanted to pay quite a sum for flying in advance, instead of giving a cash discount, we would agree that all money paid towards flying at the time of buying the contract should apply on that contract, and the contract would be valid until such money was flown out.

The following are the costs per hour incurred by the student:

Solo Hours Under Contract	Cost of Contract	Cost of Solo Time (Hours flown time solo cost per hour)	Total Cost to Student	Rate per Hour
1	$9	$6	$15	$15.00
2	9	12	21	10.50
3	9	18	27	9.00*
4	9	24	33	8.25
5	9	30	39	7.80
10	9	60	69	6.90
15	9	90	99	6.66
20	9	120	129	6.45
30	9	180	189	6.30
50	9	300	309	6.18

*It will be seen that for 3 hours flown under the contract student pays the same as "straight." For anything more than 3 hours per month, the student pays less and less per hour. The cost of time at $6 per hour is of course $9 (our regular rate) less ½ or 33⅓ per cent, and made a handy one—10 cents per minute—for figuring.

It is a nice proposition to sell, as a salesman could call on a student, "sell him a contract" for a little outlay, get the money right out of him, and therefore assure himself that the student would be out to the airport instead of just receiving his promise to start flying.—Joshua Crane, Jr., *president, Waco Sales of New England, Inc., N. Quincy, Boston, Mass.*

Installments help wage earners

For dual instruction we make a nominal charge of $10 per hour. This is figured from the solo rate plus the instructor's pay. We usually give a student a half hour of dual in each lesson, and he pays cash at the end of the lesson. By doing this a great many of the boys who draw a small weekly wage are enabled to buy at least a half hour per week. We also have a flat rate plan based on experience, of $85 to solo. This includes all dual instruction as well as the first solo and whatever additional instruction may be required up to 10 hours solo. Students who pay cash in advance for the flat rate course are given a 5 per cent discount. Otherwise they pay $35 down and two payments of $25 each, payable at the end of the third and sixth hours of instruction.

We charge $6 per hour for solo time, payable as they fly. The ship is not let out for any less than a 15-minute period. We also try to sell solo time to our students in blocks, in other words we try to contract with them for 5 hours at a time, to be flown out within two months. For this we give a discount of $1 per hour if paid in advance for all 5 hours, and 50c. per hour if paid for in installments. This contract method seems to stimulate quite a bit of solo flying.

These prices are of course figured on operating a two place Aeronca. Time being computed from the time the ship leaves the apron until it returns.—G. L. Williams, *president, Seneca Airways, Utica, New York.*

Question 3

(Answers will be published in March)

Is there a seasonal lull in your operations during winter months or in bad flying weather? What have you done to obtain business in the slow period? Are there services of a non-aeronautical nature, or other forms of work that may be obtained to keep your organization busy in off-seasons?

Question 4

(Answers will be published in April)

What are your policies for inspection and servicing of equipment? At what intervals have you found it necessary to overhaul engines; other parts of planes? How do maintenance costs vary for different types of service? What is the usual life of mechanical equipment, i.e., the time when it is more economical to replace than to repair?

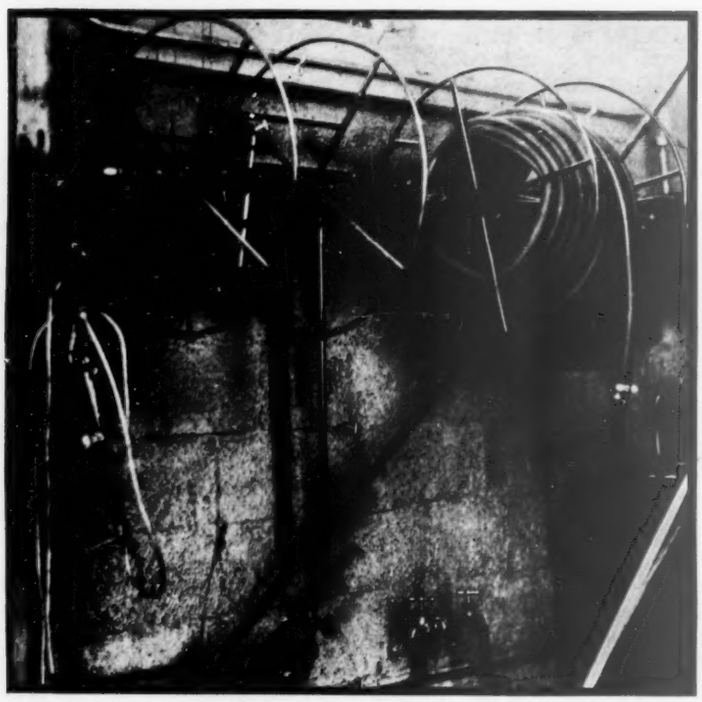
"Listening-in" on a gyroscope bearing.

THE MAINTENANCE NOTEBOOK

In cooperation with the Maintenance Committee of the Aeronautical Chamber of Commerce

Listening for Trouble

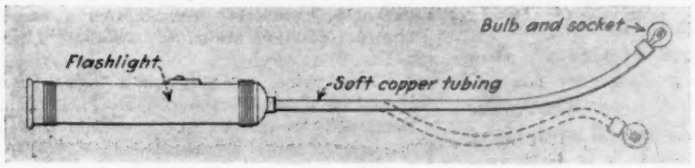
BY combining an ordinary physician's stethoscope with a mica-diaphragmed "pick-up" from an old fashioned victrola, the instrument shop of United Air Lines (then at Chicago) developed a device to detect trouble in the ball bearings of gyroscopic instruments. By applying the needle point of the pick-up to the bearing housing of a gyro in rapid rotation on the test bench, the bearing noises, ordinarily inaudible, are amplified sufficiently so that it is quite possible, with a little practice, to differentiate between a perfect bearing and one in which wear has begun to develop. By this means it is possible to anticipate trouble and to replace bearings before there is any possibility of failure in service.



EAL's hangar hose reels.

Reels for Compressed Air Hose

COMPRESSED air hose kicking about on shop or hangar floors is not only unsightly, but a distinct source of hazard. The problem of keeping air readily available and yet out of the way when not in use has been met by EAL's maintenance department at Atlanta by installing a couple of light reels (somewhat similar to those used for garden hose) on the wall just inside the main hangar door. The hose is reeled "alive," that is, the inner end is connected to the reel hub, which in turn is connected to the compressed air line through a rotating, air tight coupling. Thus, any length of hose may be paid out from the reel to the point where it is to be used. A simple crank is provided to reel in hose.



A flashlight with a long neck is a useful tool for the engine inspector.

Light for Close Quarters

MECHANICS in United's Servicing hangar at Chicago find many uses for a long-necked portable lamp made of an ordinary hand-flashlight and a piece of small diameter soft copper tubing. In place of the usual reflector, one end of the tube is fastened to the case, and the other carries a miniature socket for the bulb. An insulated wire through the center of the tube, completes the electrical circuit. The tube is about 2 ft. long (the length may be varied, of course, to fit any required conditions), it is flexible enough to be bent into odd shapes to reach inaccessible locations,—and the small O. D. of tube, bulb and socket make it possible to put the light inside of

ONE

With the wheel hub cover plate removed, mandrel is inserted in axle and airwheel servicing jack placed under the offset pad.

TWO

Jack is raised until the two swinging struts are in position to take the load. Jack is then removed and placed under regular landing gear jack pad.

THREE

Wheel raised for removal by operating jack on regular pad.

cylinders through spark plug holes, into rocker boxes or other places where space is limited.

Wheel Jack Auxiliary

BACK in the days when Ludington had a Fleetster or two in service, a gadget was devised to get around the very difficult problem of getting a jack under the landing gear when one of the airwheels went flat. Clarence Belinn, now of National Airways, has dug a few pictures of it out of the archives, and sends them in for whatever they are worth to anyone faced with a similar problem.

The tool is simple and easily made. It consists of a short steel tube mandrel of a diameter that will just slip easily into the wheel axle of the airplane. Welded to the outer end is an offset jackpad, reinforced by steel plate webs as shown at left. Pivoted through the tube under the jackpad are two steel tube struts. They are free to swing about the pivot. Each carries a flat "foot" or pad welded to the lower end. The series of pictures shows clearly the way it is used. Operators who service ships on airwheels should find a similar tool a useful addition.

Reclaiming Cleaning Fluid

WHERE large quantities of cleaning fluids are used daily to clean oil and dirt from airplane and engine parts it is worth while to consider means of reclaiming. Fortunately, the processes are not nearly as involved nor exacting as those required for cleaning lubricating oils for reuse.

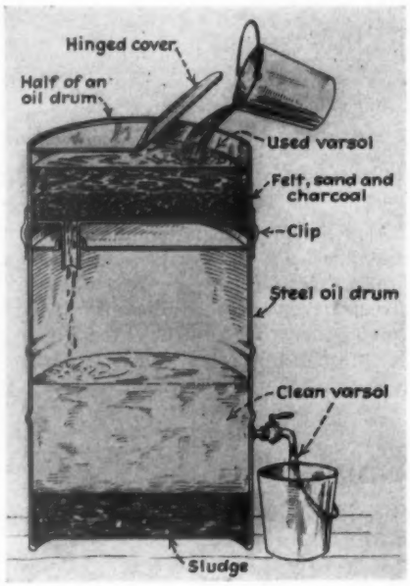
Readers will recall H. P. Taylor's "still" at the old American Airlines plants in Dallas. He dumped his used mineral spirits in an old boiler out back of the shop, heated the boiler by burning the sludge from previous reclaimings under it, and condensed the distillate in a simple pipe coil. In this way, with very little labor, he was able to reclaim some 90 per cent of his cleaning fluid.

But distillation is not necessary, in the opinion of Clarence Belinn, National Airway's maintenance superintendent. Up in Boston where he overhauls Lycomings and Stinsons, he has made a simple and effective reclaimer for Varsol out of a couple of old oil drums. Referring to the sketch, the top half of the unit is made from half a steel drum. It is, in effect, a large funnel, for a short piece of pipe has been welded, as shown, into the end bung. Over the open end is a cover, part welded on, part hinged. Four flat spring clips are welded on the sides to hold the funnel in place on top of a regular oil drum. On the latter, the spigot is removed from the end bung and screwed into the side bung. A few layers of old felt, sand and charcoal are laid into the bottom of the funnel, and the outfit is ready to operate.

As used Varsol comes back from the shop it is simply dumped into the funnel. As it works its way down, the solid particles are strained out and it drips through to the drum below. The lower half of the drum forms a settling tank, in which the sludge slowly settles and allows the clean Varsol to come to the top when it can be tapped off through the spigot. When the sludge reaches the spigot level, the drum is pulled out and sold (for the usual 50 cents) and a new one substituted. Belinn reports an average saving of 90 per cent.

Fire Extinguisher Unit

A SIMPLE steel A frame fitted with a loop handle makes a convenient means of handling a pair of 1-qt. Pyrene fire extinguishers around TWA's hangar, apron and fuel pits at Kansas City. Sheet steel panels bolted to the welded angle-iron frame carry the regular Pyrene wall type brackets.



National Airways' Varsol reclaiming plant.

A portable fire extinguisher unit.

THE BUYERS' LOG BOOK

AVIATION'S *Card Index of New Equipment*

This department is equipped to help readers locate manufacturers of any parts, accessories or materials

MATERIALS — **Koroseal**

B. F. Goodrich Company,
Akron, Ohio

KOROSEAL, a new plastic material, although not the same as rubber in chemical composition, may be molded into any shape, and resists disintegration in the presence of corrosive chemicals. The claim that Koroseal does not swell and soften in oils makes it useful for oil sealing gaskets where swelling is objectionable. It offers resistance to light and oxidation, and possesses long flexing life. Odorless.

AVIATION, *February, 1935*

ENGINE ACCESSORIES — **Tachometer**

General Electric Company,
Schenectady, New York

G-E Aircraft Tachometer operates on generated-frequency principle. Calibrated for temperature effects, pointer remains steady under all conditions. Generating unit has no brushes or slip-rings. Maintenance is reduced through direct-driven rotor. Indicator reads from 0 to 2,500 r.p.m. when generating unit turns from 0 to 1,250, but wide range of optional driven and indicated speeds available.

AVIATION, *February, 1935*

AIRPORT EQUIPMENT — **Lamps**

Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

NEW signal lamp, applicable to remote flasher beacons, embodies prefocusing collar which encircles bayonet base and, as lamps are changed by automatic device, fixes the filament position. Spiral wire eliminates lens shadow. A straight filament coil withstands the strain of constant flashing. S-11 clear glass bulb, maximum overall length of $2\frac{3}{8}$ in., available in seven amperages.

AVIATION, *February, 1935*

LABORATORY EQUIPMENT — **Milliohmmeter**

Shallcross Manufacturing Company,
700 MacDade Blvd., Collingdale, Pa.

MILLIOHMMETERS Nos. 670 and 671 measure resistance lower than that covered by ordinary Wheatstone Bridge. Applicable for testing of aircraft bonding and shielding of ignition systems. No reference curves or charts required, actual resistance being read from instrument scale. Ranges: No. 670 (.75-.3-.075-.03-.0075-.003); No. 671 (0.3-.003).

AVIATION, *February, 1935*

MISCELLANEOUS — **Blue-print paper**

C. F. Pease Company,
813-821 N. Franklin St., Chicago, Ill.

THE new Pease "K" speed paper and cloth is non-bleeding and color fast, enabling prints to be fully exposed or even over-exposed without affecting color or clarity of outline. Accommodates practically all classes of tracings at one printing speed. Available in standard weights, lengths, widths, rag stock content, in rolls or in sheets. Free samples on request.

AVIATION, *February, 1935*

SHOP EQUIPMENT — **Spray guns**

Binks Manufacturing Company,
3114 Carroll Ave., Chicago, Ill.

TWO new spray guns, "Thor" 5 and 6, are announced. No. 5 is a touch-up and shading gun, equipped with overhead trigger; No. 6, a combination touch-up and general service gun with conventional pistol grip. Outstanding feature of both guns is adjustability of spray while in use. Spray may be widened or narrowed as it is moved over work. Heads are arranged to avoid obstructing vision.

AVIATION, *February, 1935*

RADIO EQUIPMENT — **Transmitter**

Western Electric Company,
195 Broadway, New York City

WE. 14-A Transmitter, with 9-A Rectifier, is multi-frequency, crystal controlled for telephone, CW, or tone telegraph transmission, housed in individual metal cabinet 83x24x29. Preadjustable to ten frequencies, 2 to 18.1 megacycles. Output 400 watts at 2 to 12 megacycles, 300 at 12 to 18.1. Power requirements: 4 KVA, 200/240 volt, 60 cycle, three phase.

AVIATION, *February, 1935*

SHOP EQUIPMENT — **Acetylene generator**

The Linde Air Products Company,
30 East 42nd Street, New York, N. Y.

TYPE MP-4 generator is a portable unit of relatively large capacity for shop or field use. It is of the automatic gravity feed type, set normally to deliver gas at 13 lb. per sq.in. but adjustable over a range of about 2 lb. per sq.in. Capacity, 150 lb. of $\frac{1}{4}$x$\frac{1}{2}$-in. carbide, to produce 300 cu.ft. of gas per hour. Dimensions, height, 87 in., overall diameter, $42\frac{3}{4}$ in.

AVIATION, *February, 1935*